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Service and Reliability

Our Readers' Report Cards
Rate the Top PC and
Software Vendors



NETWORK EDITION

Fastest PCs Yet

First Looks at Four
133-MHz Pentiums

Internet Gateways

PC Labs Tests Four
Routes to the Net

MAGAZINE

HOW TO PICK THE

PERFECT

SYSTEMS

CD-ROM DRIVES

HARD DISKS

MONITORS

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**AN NEC
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AT THIS PRICE?**

NPR[®] CHANGED



If there is one thing we all have in common, it is a need to express ourselves. For some folks in Wyoming that need gets met every time they tune in to National Public Radio's[®] *The Thistle & Shamrock*[®] show, which airs Saturday evenings on Wyoming Public Radio. (That's 91.9 on your FM dial.)

Now aside from having a need to express themselves, NPR also has a rather urgent need to be heard. Which begins to explain why they're such keen users of Microsoft[®] Word 6.0.

You see, NPR is all about intelligent communication. So it stands to reason that they'd use an intelligent word processor:

Especially if they were trying to do something like show the station that a Celtic music program could be the biggest thing to hit Chugwater since the blizzard of '69.

For such a job they'd surely want to add charts and graphs. They'd want to drag stuff from one document and drop it into another. They'd want automatic formatting. They'd want to whip up a table of contents. Simply put, they'd want to make their point so well that the station's staff would be happy to change their programming. And why shouldn't they be? NPR already knew how it would make their listeners feel.

THE STATION IN CHUGWATER, WYOMING AND THINGS HAVEN'T BEEN THE SAME SINCE.

Of course we're not going to say Chugwater would have turned into a cultural wasteland if it weren't for *The Thistle & Shamrock* show. We're just saying that the more clearly you get your point across, the more likely it'll be heard. (Something to think about next time you're looking for a raise.)

And now for a word from our sponsor: If you'd like to hear a little more about Microsoft Word 6.0 or any of the other fine products that make up Microsoft Office, just give us a call at (800) 240-4782, Department NEC. We're pretty sure you'll be impressed with the reception.



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CIRCLE 200 ON READER SERVICE CARD

Inside

No matter what it is you're looking for, the quest for perfection takes a long time and lots of hard work. In our case, searching for the Perfect PC took the efforts of the entire staff—from our senior editors to the Labs staff, from our hard-

working researchers to the copy and production departments.

But if this issue looks unusually perfect, most of the credit has to go to our art department, headed by art director Laura Baer. Laura is a

art directors Charles Conover (an eight-year-veteran of the staff), Richard Demler, and Le Chau (Betty) Thai. Together they design the look of our editorial content, making each story attractive, compelling, and easy to digest.

The graphics that accompany the stories are often prepared by our graphics staff, headed by associate graphics director David Foster and graphic artist Mark Tyner—the forces behind many of our informational illustrations, including the "How Things Work" diagrams in this issue. Also, the team relies on talented freelancers such as Jack Harris, who prepared no fewer than 75 of the illustrations in this issue, and Thom O'Connor, who is responsible for most of the photography in the magazine.

Making the magazine look good may sound easy, but it's not: It means working with huge features that contain many "nuggets": informational graphics, tables, photographs, fact files, benchmark test charts, and, of course, text. The challenge is making all this fit and preserving its accuracy while keeping it attractive. The art staff is a diverse team, with interests ranging from fine art to computers to music, yet these folks always find the time and inspiration to make the magazine stand out.

—Michael J. Miller



Perfect artists: Laura Baer and staff.

relative newcomer to the book, having started just six months ago following a long and distinguished career at *Business Week*. Already she's made her presence known, both in the leadership she has brought to the department and in her work on our covers and on the redesign of the Network Edition and First Looks pages.

Laura's team is headed by senior associate art director Donna Panagakos, who frequently designs our cover stories, and by associate

PC Magazine: The Independent Guide to Personal Computing, ISSN 0888-8507, is published biweekly except in July and August, for \$49.97 for one year. Ziff-Davis Publishing Company, L.P., One Park Ave., New York, NY 10016-5802. Second-class postage paid at New York, NY 10016-5802 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 54093, Boulder, CO 80322-4093. GST Registration Number: R-123669673. Canada Post International Publications Mail Product (Canadian Distribution) Sales Agreement No. 266477.

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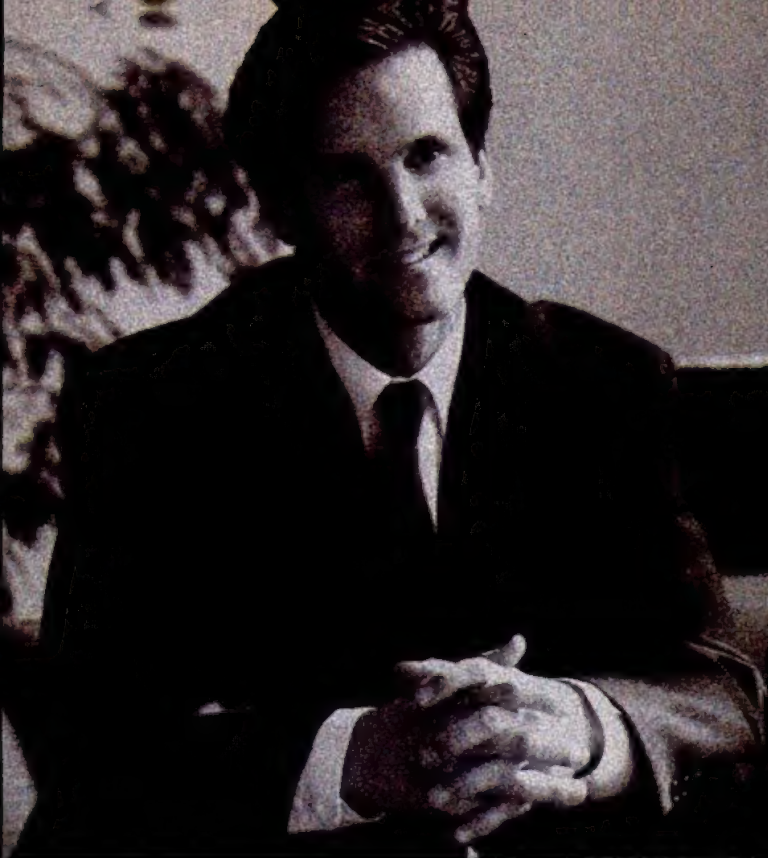
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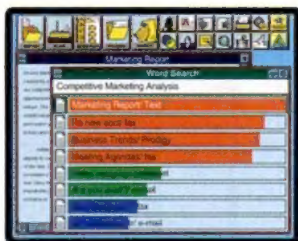
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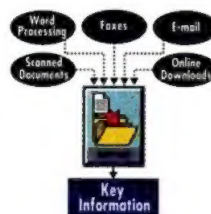


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Perfection in the PC industry
is an elusive and ever-chang-
ing goal. We've taken a snap-
shot of the machines we think
represent today's ideal in

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Special Foldout: Buying the Perfect PC

BY JOHN CLYMAN

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Computers

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BY JOHN CLYMAN

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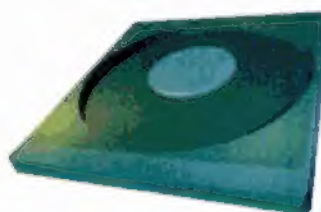
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BY TED STEVENSON

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CAROL A. VENEZIA

The spiffiest hardware in the world won't

Software

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BY SARAH L. ROBERTS

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The PC Magazine 200

AFTER HOURS

PC Magazine At Home

Making Home
A More
Colorful Place

BY BRUCE BROWN

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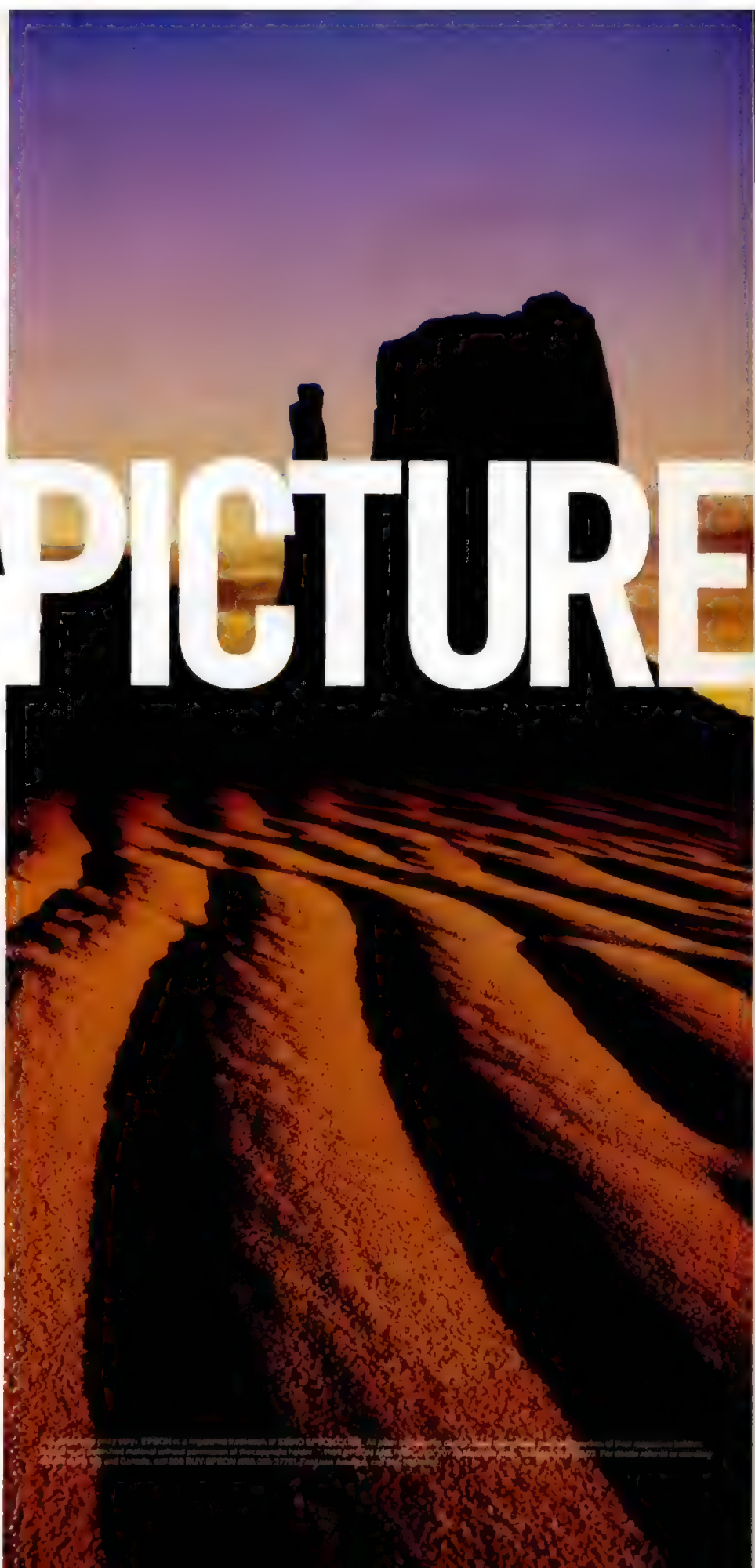
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You see, I've never actually been to Monument Valley. I've read about it in books and magazine articles. I've seen it in the television commercials for pick-up trucks and in the movies; you know, the exciting, old westerns. The buttes and the mesas; it's funny how those words rarely come up in conversation, but I'm sure if you were face-to-face with a massive, towering butte, it would stop you in your waffle-footed tracks. That's what I like about nature—its ability to remind us all that we humans are merely short-term inhabitants of our mighty Mother Earth. It's the magnificent red-hued rocks that leap up towards the breathtaking

fool us into believing that we too can create in a moment what the gods of this arid world have taken forever to construct. There is a seventeen-mile drive that winds through the ragged heart of Monument Valley. I've read that the drive provides visitors with sweeping views of the valley from different vantage points. I suppose, if you were in a hurry, this would be the way to see this place. But it's not the method I would use (why would you come here if you were in a hurry?). I'd get on a strong horse and ride wherever I wanted to go. I'd ride right up to the big rocks and stare straight up to the sheltering sky. I believe a place like this

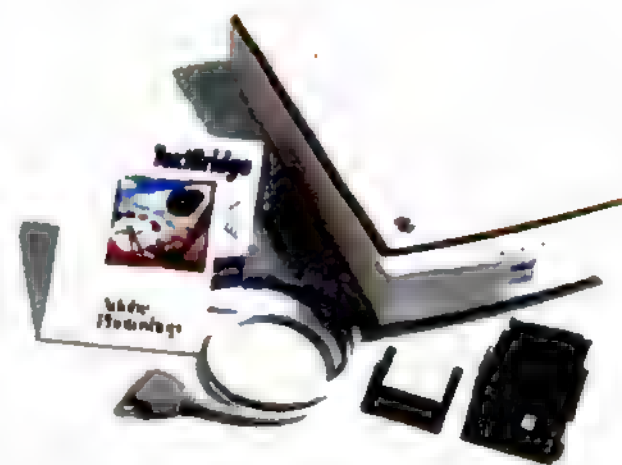
OR A THOUSAND WORDS.

class and its climate. Most of the amazing natural monuments are remnants of sandstone eroded by the million-plus-year effect of wind and water. You can't not think about your insignificance in the cosmic scheme of things, standing amid a world that does not know hamburgers by their names, the year's top money-making films, or the most-valuable player in last year's Super Bowl. Places like Monument Valley, Yosemite, and the Grand Canyon are pure. Yes, that's the word: purity. The towering pinnacles, the volcanically-inspired buttes; they are there day after day, year after year, generation after generation. Yes, always changing, but slowly, subtly, almost imperceptibly. They are in no hurry to go anywhere. Where would they go? Why would they need to? No, they have already arrived. So it is we humans who go to them, we Mohammeds to our mountains. In our shiny new four-wheel drives and recreational vehicles. We go out from the towns and cities in droves. We go to sit at the foot of these geological icons of the American West. We go to touch our own Indians. To find some connection between what nature has carved out of this ancient place called Monument Valley and our own modern lives. Of course, I suspect most of those who come don't—or can't—see the connection. The monuments of our settled lives are made

absolutely nothing from us. It is a self-sufficient kingdom of layered sediment, simultaneously eternal and impermanent. Nothing we say or write about Monument Valley makes it more or less powerful. Yet we are moved to react to its noble beauty. And in reacting, we praise the purity—there's that word again—of this place. And, in appreciating Monument Valley, we learn to appreciate what is good and important in our lives. The immutable laws of nature remind us to stop and smell the flowers, to cherish our children, to revere our parents and grandparents, to love one-another as we love the majesty of these monuments. This place is a magical looking-glass through which we may see the true character of our souls. I have this vision of Monument Valley in my head. And when I see this vision, I feel closer to a world that embraces me; a world that invites me to share in the sovereign beauty of rocks that rise towards the heavens and dunes that run forever. They remind me that, no matter where I go and what I do, I will always feel these monuments in my heart. I will always hear the chattering wind in my head. I will always see the extraordinary silhouettes of the ages. And I will always find a reason to keep going forward. I have this vision of Monument Valley in my head.

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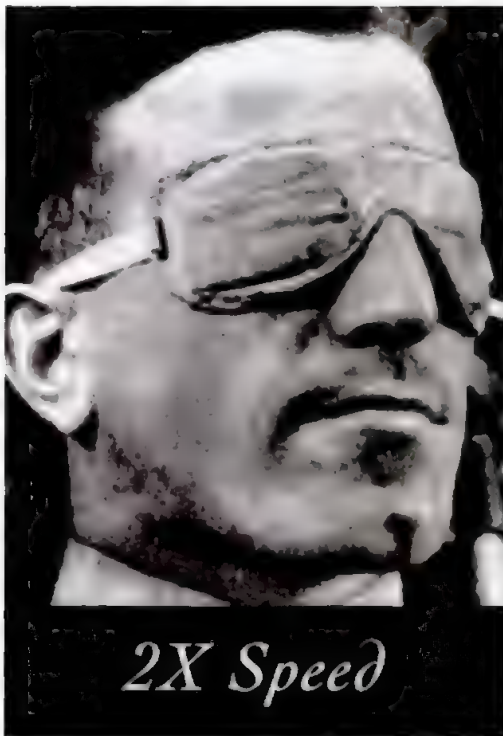
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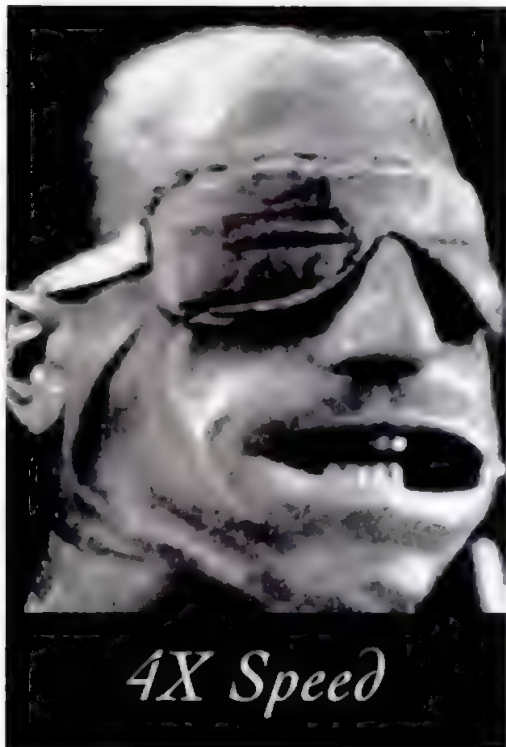
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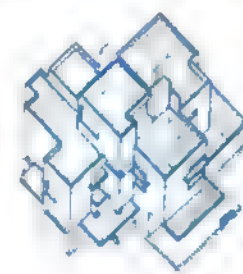
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Letters

INFORMATION SHORT CIRCUIT

Response to John C. Dvorak's column "Info Overload at Your Fingertips" (March 28, 1995) was as opinionated and divergent as the perspectives found on the Internet itself.

Dvorak's diatribe against the Internet and the World-Wide Web had some good points but was a little extreme. He fails to account for the embryonic state of the Web. True, many sites provide vapid infotainment, but there's a need for this, too, and the number of outstanding informative sites keeps growing. While the shakeout is in progress, each user must learn to extract the gems from the ore, which is admittedly no mean feat. Rome wasn't built in a day, and neither will the Web be.

PAUL KLOSE,
Redondo Beach, California

The inevitable disappointment may be lurking out there, but that's okay with me, because without the tantalizing potential of discovery, I never would have become involved with the Internet. There's no end to progress. Who's qualified to evaluate one's need to view an image of J. D. Salinger's backyard?

J. DASHEN, via the Internet

The existing Internet search tools do indeed put information at your fingertips. People most certainly waste time on the Net. People also waste time playing Windows Solitaire. Any medium can be misused or abused in some fashion. The "nuttness" Dvorak sees is just excitement over a new and burgeoning information industry.

JOHN DELANEY, via PC MagNet

Dvorak's column was disappointing. We are only as overloaded as we let ourselves become. There is just one way for the Internet to develop, and that's with dynamic expansion. Let the entrepreneurs out there look for ways to make the Internet easier to use.

DAVID KAPANKE, via the Internet

Unfortunately, Dvorak is right; there will always be those who find ways to make a useful tool unproductive. But let's not allow that inalterable fact to ruin it for those of us who use those tools to become more productive.

JAY BYARS, via PC MagNet

Of course the Internet can be a big time-waster, and I'll be the first to plead guilty. What Dvorak's experiencing is the difference between going to your local convenience store and shopping in a discount warehouse; the sheer vastness of the environment requires an adjustment period directly proportional to the size in question.

DAN LUTHER, via PC MagNet



*While the shakeout continues,
each Web user must learn to
extract the gems from the ore.*

For every person I know of who's using Web resources to aid work or research, I know of ten who are just goofing off. The Internet can certainly enhance your personal life, but let's not fool ourselves into believing that it will ever be a productivity tool. It's more of a workplace unproductivity tool.

DAVID PAUL, via the Internet

Dvorak hit the nail on the head. I was so hooked on on-line that I'd spend hours a day "talking" to people around the country, while virtually ignoring my "live" friends and family. The industry is partially to blame for making everyone think they need this technology. I quit cold turkey, and two months later I hardly miss it. Now I use on-line services as a tool, not a pastime.

ELIZABETH SOBON, via the Internet

If you come across a site you don't agree with, you can choose to leave that site. Would Dvorak prefer that a hoard of government censors patrol the Net looking for information they consider undesirable or too radical for general consumption?

JACK REED, via the Internet

I wholeheartedly agree with Dvorak. There may be top-notch research information available at various Internet sites, but I'm tired of wasting time wading through inane newsgroup postings and Web sites.

JOHN PARADISE, via the Internet

That information is not controlled is just one of the Web's strengths; we are witnessing a

new age in communication, perhaps as important as the invention of the printing press itself. What the Internet can offer is just becoming clear, and its rapid evolution will sculpt the landscape of personal computing and even society. It's not so much what can be done now as what we will be able to do that has people so excited.

HAROLD WEISS, via the Internet

The Internet may be heading for disaster, but in the meantime it's a great source of fun.

TERRY MCLAFFERTY, via the Internet

By implying that without central control the Internet is doomed, Dvorak forgets that the Net isn't a thing; it's the sum total of all the computers that individuals have decided to connect together to share information. The Internet is essentially a network of people. The computers are just the physical mechanism for that network.

DUANE TAKAMINE, Honolulu, Hawaii

A WELL-WORN PASSPORT

I've enjoyed visiting the World-Wide Web sites mentioned in Michael J. Miller's column "Where Do I Want to Go Today?" (March 28, 1995). As an avid "real-world" traveler, I enjoy traveling in cyberspace when I can, and Miller's column provided a nice passport for on-line travelers.

JERRY BROWN, via the Internet

Miller's column was an intelligent look at the Internet, but I was a bit disappointed that many of the sites mentioned are relatively common. Although those sites are worthwhile and useful, they're also a bit old hat. Bravo for mentioning the interesting, off-the-beaten-track sites that aren't the Net-scape standards; I found those much more enjoyable.

RICHARD FRANKEL, via the Internet

SECOND TIME'S THE CHARM

Bill Machrone's new Second Looks column is by far the best aspect of PC Magazine. Second Looks is really the only place to read about long-term, everyday use of products and services that really cost a lot of money. My only question is, why isn't it two pages?

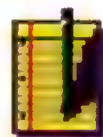
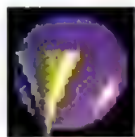
EDWARD IPP, via the Internet

Thank you for the Second Looks column. It's a subject whose coming was long overdue.

ANDREW MILLER, via PC MagNet

Second Looks is an excellent idea. Because I'm a user whose wallet is always smaller than his wish list, a second, more informed opinion is warmly welcomed.

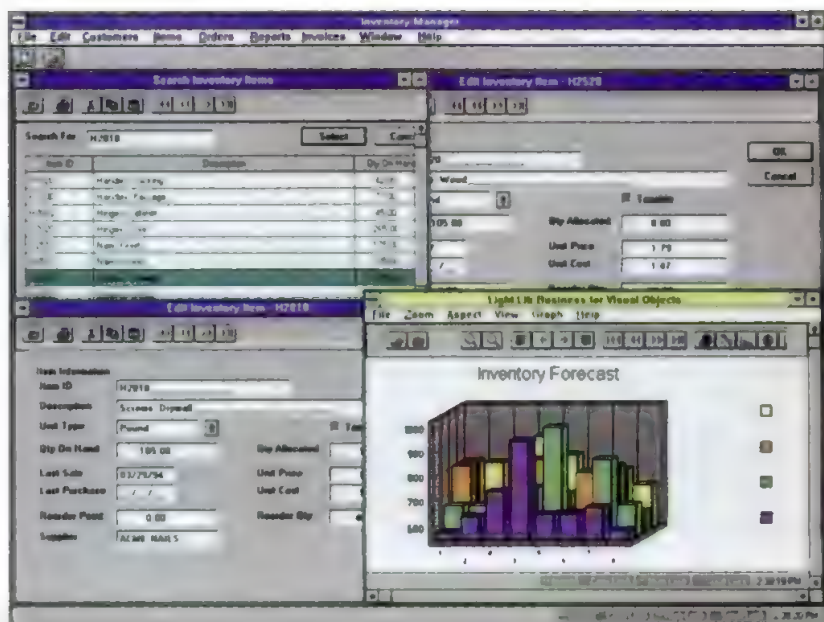
BRUCE A. WAHLER, via PC MagNet



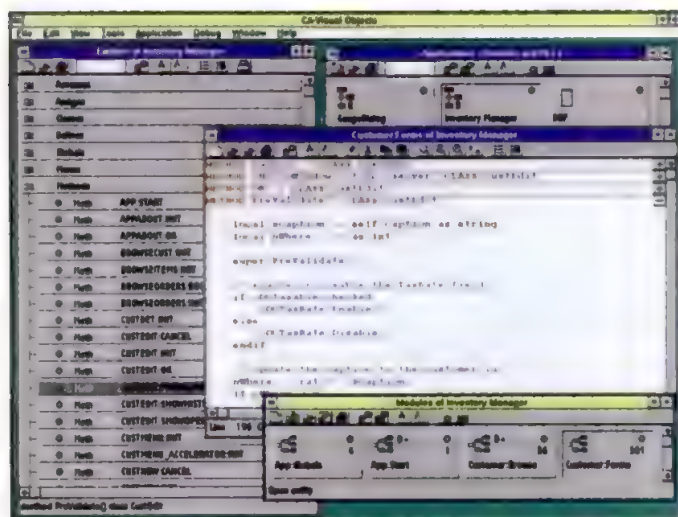
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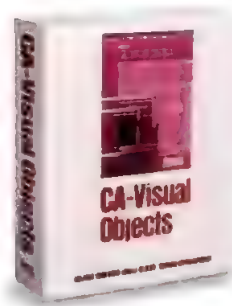
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Letters

Second Looks offers exactly the kind of information users need. We want to know what works in the real world and what problems people typically have or can expect from a product.

MIKE NEWMAN, *via the Internet*

PULL UP A BAR STOOL

Thank you, Bill Machrone, for a well-written, up-to-date, and positive column on the current and future states of the bulletin board system (BBS) industry ("Where Everyone Knows Your Name," March 28, 1995). As a longtime BBS user and sysop, I can vouch that Machrone uncovered the merits of the BBS community.

TONY MCCLENNY, *via the Internet*

Machrone's assessment of the present and future of the BBS community was a service to sysops and users alike. It was accurate and straightforward and particularly helpful in defining how BBS systems will coexist with the global information infrastructure.

DAVID P. MCCLURE,
*Association of Online Professionals,
Via the Internet*

I cringed when you referred to *Boardwatch's* editor as "Jake Richter." In the BBS community, the man and his magazine are a legend. Any piece about BBSs should mention both, as Machrone did—or at least I think he did. For the rickard—uh, record—Jack Rickard is the one Machrone meant to credit.

RICK SINK, *via PC MagNet*

FORTIFIED MEMORY

Your article "IMBFort Protects Low Memory" was terrific (March 28, 1995). It not only

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CORRECTIONS AND AMPLIFICATIONS

In "Tapping the Promise of the Pentium" (May 30, 1995), the review of Sys Technology's Performance P100T should have indicated that the machine used an ATI Graphics Pro Turbo adapter with 2MB of VRAM and that the system's 256K of pipelined-burst synchronous cache is expandable to 512K.

delivered two extremely useful utilities, but it also found an easy and understandable way to explain this particular limitation.

RICHARD LEBEDA,
Frauenfeld, Switzerland

The 1MBFort utility is great! This is exactly what I needed. Another great utility.

MICHAEL GIROUX, *via PC MagNet*

THE MULTIPLE SIDES OF MULTIMEDIA

Thanks for the in-depth coverage of the current wave of multimedia peripherals ("Multimedia à la Carte," "The Newest Spin on CD-ROM Drives," and "An Earful of Sound Boards," March 28, 1995). I postponed my next multimedia purchase in anticipation of this issue. As an addendum: The poor man's multimedia speaker system, which plugs a boom box or other audio system speakers into the sound card, can offer sound quality that's really quite good.

LYLE MARIAM, *via PC MagNet*

Congratulations on a most thorough evaluation of sound cards.

PERCY WEGMANN, *via the Internet*

The one thing that you overlooked is the data capacity of these CD-ROM drives. Many manufacturers make substandard drives that can't read the up to 650MB of data stored on a Level 1 (data)-formatted CD-ROM.

ROBERT HUGHES, *via the Internet*

Thanks for the wealth of information in your review of sound boards; it brought together in one place much of the comparative information needed to make an informed choice. But there was no mention of driver support for these boards under anything but DOS and Windows. Specifying the availability of drivers for OS/2 and other operating systems would be useful.

ROD SMITH, *via the Internet*

Your comments regarding the amount of memory required for the Creative Labs AWE32 card's drivers were most informative; many of us are constantly fighting RAM cram. Such information can be very useful.

KEVIN GALLAGHER, *via the Internet*

We're considering adding these and other criteria to our future multimedia reviews.—Ed. □

WE'VE ALWAYS SAID OUR MONITORS ARE TRIUMPHS OF TECHNOLOGY. NOW, IT'S OFFICIAL.



The Nokia 447X has just been named a Best Buy by *PC World*. This adds to a long and growing list of awards and honors for Nokia monitors.

Ever since their introduction in the U.S., Nokia has been recognized by editors and sophisticated users alike as technologically superior. The displays are brilliant and tack-sharp. The ergonomics are an exuberant expression of Nokia's European home.

Nokia "firsts" read like a history of advanced monitor technology; including the world's first TCO and MPR II-certified emissions control and the first all digital monitors with on-screen menu controls.

As the need for quality monitors expands into

more homes and businesses, the appreciation of Nokia excellence grows with it. And, as more people look into Nokias, they are finding more than technical superiority. They're finding superior value.

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While each Meridian product is distinct, they all have several hot features that add to their impressive speed and ease of use including local bus video; a comfortable palm rest with an integrated TruePoint pointing device; and an 84-key keyboard.

Meridian 400 Subnotebook



"ZEOS is out to prove that good things do come in small packages with its Meridian 400C subnotebook," reported *Windows Magazine*.

At 3.9 pounds, the Meridian 400 subnotebook is molded with a special carbon-fiber material that cuts weight and improves durability. And with your choice of a 486DX2-50 or DX4-100 processor, hard drives to 350MB, and RAM that's user upgradable to 20MB, this notebook is "faster than a speeding desktop," as *Computer Shopper* said.

The 400 features active and dual-scan color screen options. You also

get two Type II PCMCIA slots and an external ultra-light 3.5" 1.44MB floppy drive (included in Packages 2 and 3).

Meridian 800 Notebook



"The 800C notebook offers sleek styling, solid construction and hot performance.... one of the fastest notebooks we've ever tested," said *Windows Magazine*.

At 6.3 pounds, the Meridian 800 full-size notebook is light enough to travel anywhere yet it's large enough to use for presentations and everyday computing. And with your choice of a 486DX2-50 or DX4-100 processor, removable hard drives to 528MB, and RAM that's user upgradable to 20MB, this notebook is the raciest thing around.

For your viewing pleasure, the 800 is available with your choice of color displays—a whopping 10.3" dual scan or 9.5" active. You also get two Type II or one Type III PCMCIA slots, and an internal 3.5" 1.44MB floppy drive.

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For turbo power, the Meridian 850 comes with a Pentium-75 processor; 8 or 16MB RAM—user upgradable to 32MB—with 256K synchronous SRAM cache; and removable hard drives to 810MB. For the best viewing, the 850 is available with your choice of color displays—

a mammoth 10.3" SVGA (800 x 600) dual scan or 9.5" active matrix. You also get 16-bit stereo sound through audio jacks (Sound Blaster Pro compatible) for the best in portable multimedia, two Type II or one Type III PCMCIA slots, and an internal 3.5" 1.44MB floppy drive.

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	DX4-100	\$2395	\$2595	DX4-100	\$2695	\$2795	DX4-100	CNI \$2995	CNI \$3095
	Active Color	400A	800A	Active Color	400A	800A	Active Color	400A	800A
	486DX2-50	\$2695	\$2995	486DX2-50	CNI \$2995	CNI \$3195	486DX2-50	CNI \$3295	CNI \$3495
	DX4-100	\$3095	\$3395	DX4-100	CNI \$3395	CNI \$3595	DX4-100	CNI \$3695	CNI \$3895
	➤ 4MB RAM ➤ 260MB IDE hard drive ➤ 800: Internal 3.5" 1.44MB floppy drive ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Works			➤ 8MB RAM ➤ 350MB IDE hard drive ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ Custom nylon carrying case ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Works			➤ 8MB RAM ➤ 350MB IDE hard drive (400), 528MB IDE hard drive (800) ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ 14.4 PCMCIA fax/modem ➤ Custom carrying case. 400: Leather, 800: Nylon ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Works		

Pentium	Package 1		Package 2		Package 3	
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	Pentium-75	\$3295	Pentium-75	CNI \$3795	Pentium-75	CNI \$4195
	Active Color	850A	Active Color	850A	Active Color	850A
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	➤ 8MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Works		➤ 16MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Office Pro		➤ 16MB RAM, 256K synchronous SRAM cache ➤ 810MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ 14.4 PCMCIA fax/modem ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ MS Office Pro	

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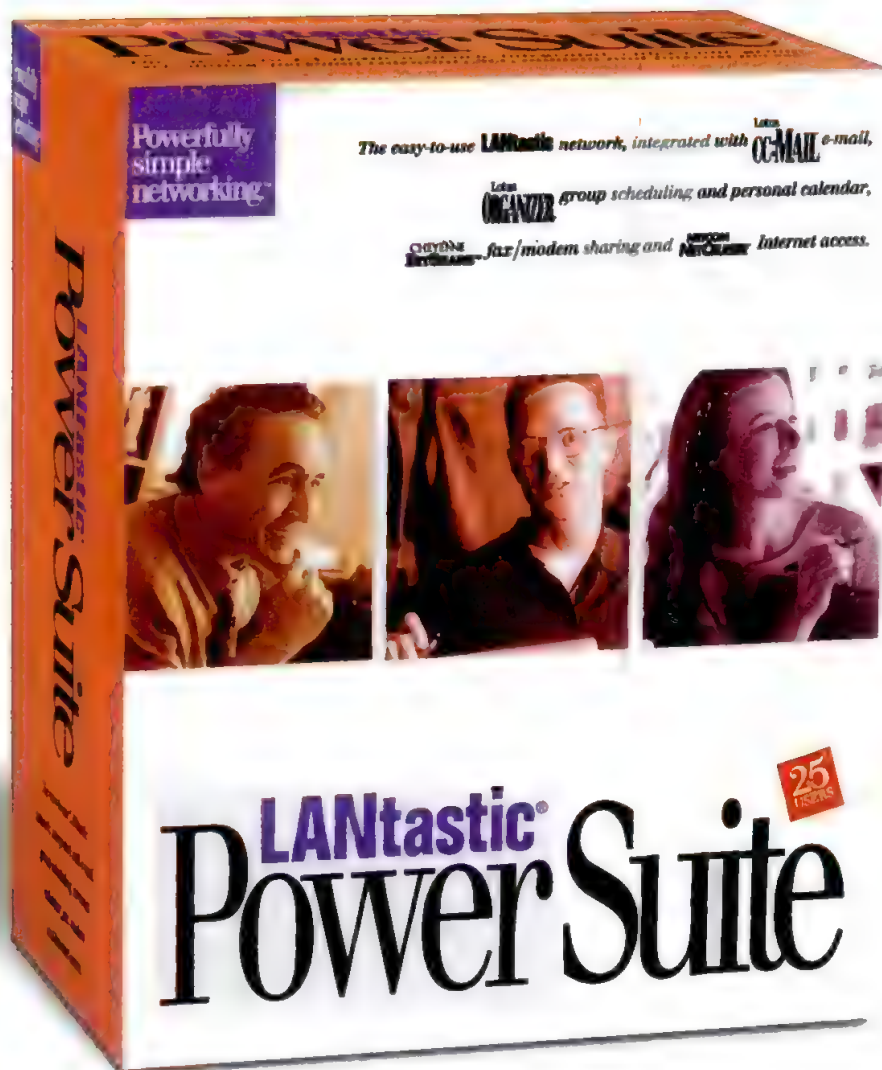
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TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Stomping Out Cybersmut

Will politicians or software get there first?

In the race to restrict access to pornography in cyberspace, technological and political solutions are running neck and neck. Earlier this year, the Senate Commerce Committee voted rousingly to approve the Communications Decency Act, which would ban porno-

graphy on the Internet and on-line services. Then, in a recent letter sent to Senator Patrick Leahy (D-Vermont), the Department of Justice weighed in against the act, saying that "it threatens First Amendment and privacy rights and would severely complicate efforts to prosecute child pornography cases" (the full text is at <http://www.cdt.org/policy/freespeech/doj-050395.ltr.html>). The Department of Justice also called for investigation into technical means to restrict access to pornographic on-line content.

The Decency Act, proposed by Senator James Exon (D-Nebraska) in an effort to make "those who would pervert networks think twice," has been widely criticized by on-line service providers and those who support an uncensored Internet. "It's unconstitutional and unfairly aims liability at service providers," said Sam Pfeiffer, an attorney specializing in First Amendment law at the Chicago firm Sonnenschein, Nath, and Rosenthal.

At the same time, though, parents and teachers have grown increasingly outraged at the proliferation of sexually explicit material in Internet newsgroups, home pages, and on-line services.

There are a few emerging technical solutions to screen out on-line pornography, but the challenge is monumental. "We have a 95 percent solution for screening



Internet pornography, but new explicit material is added every day and no solution is perfect," says Jay Friedland, vice president of SurfWatch Software, a Silicon Valley startup (<http://www.surfwatch.com>). Its SurfWatch Internet screening software, however, is based on an underlying database of protocols corresponding to over 1,000 Internet sites known to include pornography.

On the on-line service and Web-browser fronts, there are efforts to screen out pornography. CompuServe's Pierce Reed says that CompuServe constantly updates a database of lewd keywords. And America Online includes AOL Parental Control, which empowers parents to screen out unwanted material. Several upcoming Web browsers will include screening algorithms like the ones you get with SurfWatch.

—Sebastian Rupley

Color Counts

IN THE MARKET FOR A PRINTER? Color ink jet printers have been selling like wildfire, and many of the tradeoffs between color ink jets and laser printers are blurring.

According to BIS Strategic Decisions, the color ink jet market has grown 261 percent annually since 1992, far outpacing the color laser market. Especially in the personal and home computer market, where network capabilities and speed aren't as important, color ink jets are growing phenomenally.

Speed remains the biggest advantage that both color lasers and monochrome lasers have over color ink jets. A color ink jet printer can print about one page with 30 percent color coverage per minute, while a color laser printer can do 4 to 5 pages in the same amount of time.

Other advantages have eroded, however. Color ink jets and monochrome lasers are now about equal in price. And there are no significant differences in costs-per-page for color ink jet and color laser print jobs on average-quality paper. (The more expensive paper used for higher-end color laser print jobs can add up.) There are fewer huge differences in print quality between color ink jets and color lasers, although the lasers are capable of somewhat smoother color gradation.

Color lasers still cost thousands more than color ink jets, which now start at under \$300. Noel Jones, Lexmark's manager of printer marketing, says prices will come down on color laser printers throughout 1995, creating more demand for them, especially in workgroups. For now, Jones says, "Color lasers are extremely expensive, and for small offices and homes, it's getting very hard to sell monochrome lasers when the same price buys you ink jet color."

In workgroups, however, color ink jets still can't compete with faster, network-smart laser printers. Analysts at BIS Strategic Decisions estimate that by 1998, nearly half of all laser printers sold will be attached directly as network nodes. That bodes well for lasers, even as color ink jets flood the fast-growing personal printer market.—Sebastian Rupley

Pipeline By Robin Raskin

The Killer App Connection

No matter where I go, the question comes up over and over again: What will be the killer app for Windows 95? Now that I've had the opportunity to preview the first 25 or so of these applications, I'm convinced that there isn't one — at least not in the traditional sense.

The reason you'll want Windows 95 is not to run some killer app. You'll want it because you'll finally be able to run the killer apps that you already own. You'll be able to do the things that you thought you'd be able to do with Windows 3.1. In other words, you'll be able to run five or six of your major applications at once.



Everything else that Windows 95 versions of existing applications bring to the table is, at best, modestly evolutionary. I've yet to see one that would make me want to run out and upgrade immediately. The first group of Windows 95 applications that we'll see will all have minor improvements that will make them run more smoothly and more uniformly. They'll concentrate on implementing standard Windows 95 conventions:

long filenames, a Microsoft-sanctioned user interface, tear-off menus, Wizards and help, and re-engineered 32-bit code that takes advantage of a flat memory address space. Most of these changes are welcome; none are earth-shattering.

Some of the changes in Windows 95, such as the common menus, will wind up causing some initial confusion. Publishers

will try to shoehorn regulation user interfaces onto their applications in order to earn their Windows 95 logos. HSC Software, a renegade in the push for uniformity in user interfaces, loves to tell me why Kai's Power Tools would look pretty silly with standard-issue File, Edit, and View menu bars.

In the longer term, the killer app in Windows 95 lurks under the surface in the operating system's built-in connectivity to the Microsoft Network (MSN). And while other publishers may be slower in catching on, the fact that you're a button-click away from an on-line service has not been lost on Microsoft. Microsoft Publisher, Works, and Office will have one-button connections to the on-line service, where you can go to get on-line help, tips, forms, templates, and who knows what else. Next year's versions of Encarta, Cinemania, and some sports titles will also have on-line connections built into the box. Your desktop application can be constantly refreshed, enhanced, expanded, and extended by the on-line service.

Obviously, this leaves Microsoft in a terrific position to make a pile of money by providing a slew of never-been-seen-before aftermarket services. Whether that's another stake in the ground for Microsoft's total world domination is fodder for another discussion. It's not the point right now. The point is that the killer app lies in harnessing the power of the on-line connection and using it to strengthen product offerings.

Marshall McLuhan's prophetic "the medium is the message" notion has a less abstract analogy: The computer is the network. If I were building a Windows 95 application right now, you'd better believe that an on-line connection would be tops on my list of priorities.

Robin Raskin is the editor of PC Magazine.

CD 'Zines Sell Ads by the Byte

PAPER MAGAZINES LIKE THE ONE you're holding now are useful for both readers and advertisers, but magazines on CD-ROM have special advantages. From the advertiser's viewpoint, the fact that CD-ROM-based ads can talk, sing, and dance just as they do on TV (and can't effectively do on the Internet yet) is compelling, to say the least.

While the first wave of CD-ROM-based general-interest magazines—including *Blender*, *Medio*, *NautilusCD*, and *substance .digizine*—have done a good job of collecting and presenting multimedia content and ads, the latest publications are slicker than ever. More important, they seem to have found successful advertising models that can help ensure their survival.

Among the new CD 'zines is *Launch*, an \$8.99 disk from 2Way Media. The bimonthly publication, which is aiming for a circulation of 150,000, focuses on popular music, entertainment, and animation. It has movie

trailers and audio and video clips from over 20 recording artists, as well as a special performance from a guest artist who records a unique version of a song and an interview for the disk. *Launch* charges \$2,500 per megabyte for ad space, and the first disk has 160MB of interactive multimedia ads from 14 advertisers including Reebok, Sony, and Dewar's—which built a 20MB ad complete with games. Though one ad is always run-



ning on the main menu, most of the ads are active only when you click on them.

Marinex Multimedia's \$9.95 *Trouble and Attitude* CD-ROM-based magazine is gunning for a circulation of 75,000 with its male-oriented mix of entertainment and music features. Advertisers have two options: either a segment sponsorship (around 5MB of disk space or 30 seconds of video) for \$20,000 to \$25,000 or a quick 3- to 5-second billboard for \$4,200. The magazine will also run movie trailers for \$38,500. No ads appear on *Trouble and Attitude*'s contents page.

Also new on the CD 'zine scene is Light Rail Communications' *Control*, a high-end music technology disk with a more targeted initial circulation of 15,000. The premiere issue, due this month, features 160MB worth of ads from 15 advertisers who are paying an average of \$500 per megabyte, though allowances are being made for certain types of ads—such as those based on RedBook audio files—that take up lots of disk space for a relatively short running time.

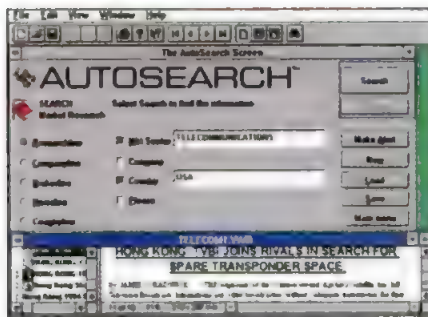
—Don Willmott

The Shipping News

THERE'S A RENAISSANCE UNDER way in on-line news delivery. From new technology to mega-deals, electronic news and business information is being sliced and diced as never before.

One of the most sophisticated new marriages of search technology, miles of content, and low cost is Profound, a spin-off of the New York-based Market Analysis Corp. For a \$19.95 monthly fee plus \$6.95 per hour on-line, Profound offers access to big news databases. Profound's CEO, Dan Wagner, says it's designed to compete with more expensive competitors such as Dow Jones, Lexis/Nexis, and CompuServe by "keeping users off-line."

Profound is the first news service to integrate Adobe's Acrobat technology, so documents can be viewed in native format. The service employs proprietary technology called InfoSort, which easily makes searches narrower and broader. For example, you might pull up a Country InfoSort Navigator, pick North America, then click on buttons that say Narrower and Broader as you navigate through headlines. The approach beats



Profound's search abilities go way beyond other on-line news services. And you don't pay as you go.

keyword searches, and you pay only when you've arrived at the news you want.

Massachusetts's Individual Inc., which has been offering the First news service for years, now offers a World-Wide Web-based news service, making it the largest news service on the Web. It features over 1,000 news topics, with 5,000 to 6,000 new stories added each day. There aren't yet sophisticated

search capabilities, but headlines are displayed in a hierarchical format. If you're looking for news on ISDN, for example, you can drill down from a "Telecommunications" heading. The fee structure isn't set yet, but a free trial is available now at <http://www/news-page.com>.

Publishing companies are quickly moving news operations on-line, too. Knight-Ridder's Web-based content includes news stories from many of its newspapers, including the *The San Jose Mercury News*. Fee-based services, such as The Mercury News's Mercury Center, feature paid advertising and demos of advertisers' products for under \$10 a month.

On the deal front, MCI has agreed to inject \$2 billion into Rupert Murdoch's global media empire News Corp. The goal is to marry MCI's global network with News Corp's content. It's not clear yet whether the marriage will result in an on-line service, but that's a likely avenue.—*Sebastian Rupley*

Winsock Brings Harmony to Net Apps

THE WORLD-WIDE WEB OWES much of its success to a key piece of software known as Winsock, which enables Windows applications to communicate with TCP/IP, the language spoken by all computers connected to the Internet. Winsock—short for Windows Sockets Application Programming Interface—is the glue that connects Web browsers, database servers, network management packages, and groupware applications to the Internet.

Since Winsock is an open standard, TCP/IP vendors have implemented their own variations over the years. And with hundreds of Winsock-capable applications on the market today that adhere loosely to the spec, interoperability is not guaranteed.

The new capabilities supported in the upcoming release of Winsock 2.0 increase the potential for conflicts. Winsock 2.0 will give developers a single API to access multiple network protocols, including ATM, ISDN, Novell's IPX/SPX, TCP/IP, and wireless. It will also offer multimedia support and enhanced data communications facilities. The number of applications that rely on communications over the Internet is expected to mushroom.

To ensure greater interoperability of Winsock software products and reassure managers of large enterprise networks that their Internet applications will work together harmoniously, Stardust Technologies recently opened the Winsock Interoperability



Lab. Stardust Technologies, co-founded by Martin Hall, the originator of the Winsock standard, will test applications and issue a certification logo that guarantees Winsock interoperability.

Intel and Microsoft are working on the Winsock 2.0 software developer's kit, which is scheduled for availability at the end of the year. Stardust will announce the first round of certification awards in July. The latest information on Winsock is available at <http://www.stardust.com>.—*Carol Levin*

Internet-Ready PCs

PC vendors are starting to preload complete Internet solutions onto systems geared toward home users and mass retail markets.

So far, Netcom's combination of easy-to-use NetCruiser software and Internet access is the leading choice for PC vendors. For the moment, PSI Pipeline and Connectsoft are the other competing Internet service providers. Acer, Canon, and NEC are now preloading NetCruiser software and offering an Internet connection through Netcom. Meanwhile, other vendors including Apple, AT&T, Gateway, and Micron are also looking into similar bundling deals.—*Melissa J. Perenson*

Top Retail Software

Current ranking	Last issue	Product/company
1	—	Quicken Financial Planner Intuit Inc.
2	5	Procomm Plus for Windows 2.1 Datastorm Technologies Inc.
3	7	MS-DOS 6.22 Upgrade Microsoft Corp.
4	3	WinFax PRO 4.0 Delrina Corp.
5	—	CorelDRAW 3 Corel Corp.
6	—	WordPerfect 6.1 for Windows Upgrade Novell Inc.
7	—	WordPerfect 6.1 for Windows Novell Inc.
8	4	QEMM 7.5 Quarterdeck Corp.
9	9	MS Windows 3.11 Microsoft Corp.
10	8	WinCheckit 2.0 Touchstone Software Corp.

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending May 6, 1995; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

The Graphics Motherboard

MEMORY IS A TERRIBLE THING TO waste, and chances are you're wasting hundreds of kilobytes right now.

Consider this: An 800-by-600 display at 256 colors requires 470K of memory. On a 1MB graphics card, that leaves 550K of memory untapped. A 2MB graphics card gives you the extra speed and color depth of a 64-bit bandwidth, but it wastes even more

memory (see diagram).

A new kind of memory scheme designed to make more efficient and economical use of graphics memory could help to bring down the cost of mainstream multimedia PCs. Weitek Corp., a leading chip set supplier, has been working on a new graphics memory architecture called Unified System Display Architecture that's designed to

bring 64-bit graphics and improved multimedia performance down to mainstream PCs.

The secret isn't an exotic new memory technology but a tried and tested idea descended from the Macintosh, which handles graphics directly on the motherboard rather than on a separate graphics card loaded with memory. In systems

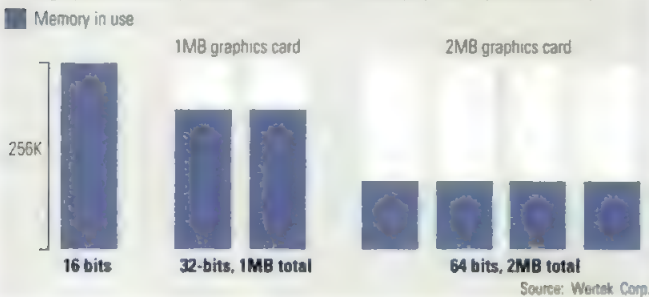
designed with the Unified System Display Architecture, a single pool of 64-bit-wide DRAM serves as both system memory and graphics frame buffer. Memory that's not used by the display is available to the operating system and applications. No waste. A single controller handles both graphics memory and main system memory. Weitek recently introduced its Unified System/Display Controller and expects to be in full production in the third quarter.

OPTi, another leading supplier of core logic and multimedia chip sets, is also working on a way to unify main systems and graphics memory and bring down the price of PCs in the cost-sensitive market. OPTi's solution calls for sharing memory but not controllers. The graphics controller can be on a separate card or on the motherboard.

While both these approaches enable PC makers to use commodity DRAM chips for both system memory and for graphics—shaving \$30 to \$40 from system cost—neither of these approaches is targeted at high-performance graphics, which require dedicated cards (see story below). The mainstream market, however, remains significant: Sixty percent of the PCs sold worldwide today have graphics integrated onto the motherboard —Carol Levin

Inefficient Memory

On a typical 1MB graphics card, a 1,024-by-768 resolution display with 8-bit color uses only 768K and wastes 256K. A 64-bit, 2MB card at the same display mode uses 768K and wastes 1,280K. In a PC that uses a unified-memory architecture, all graphics-memory needs are handled efficiently by main system memory.



Next-Level Multimedia Performance

PC GAMERS ARE AFTER THE VISCERAL rush of vivid imagery, convincing special effects, and responsive game play, but game developers are in a bind. They can create games for either performance or ease of use, but not both. They go with DOS for speed or with Windows for compatibility. A new graphics hardware architecture from Nvidia Corp., a Sunnyvale, California-based newcomer founded just over a year ago by veterans of Sun Microsystems, and chip manufacturer SGS-Thomson Microelectronics is

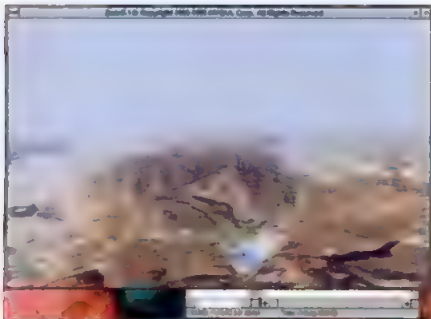
designed to bring multimedia performance under Windows to a higher level.

While the unified memory architecture discussed in the story above is designed primarily to shave cost from mainstream PCs, the Unified Media Interface and NV1 chip are designed to bring new capabilities to the PC. Nvidia's NV1 chip puts all multimedia processing under one roof, including real-time photorealistic 3-D processing, high-resolution graphics, wavetable audio, and video playback. The features are integrated via the Unified Media Interface, which gives graphics card developers a single multimedia architecture to work with.

Nvidia has taken a different approach to real-time 3-D animation. Instead of building 3-D objects from flat polygons, which demand a huge number of calculations to manipulate, the NV1 chip creates them using a smaller number of *curved-surface polygons*. This offloads the job from the CPU, which, if used to generate 3-D polygonal transformations, would bring the system to its knees. The chip should be in cards available later this year from Diamond

Multimedia and other vendors. They're expected to sell for around \$200, hundreds of dollars less than a multimedia subsystem using separate components.

Nvidia is not the only player aiming to raise the level of multimedia performance. Lockheed Martin and Sega plan to ship a high-end



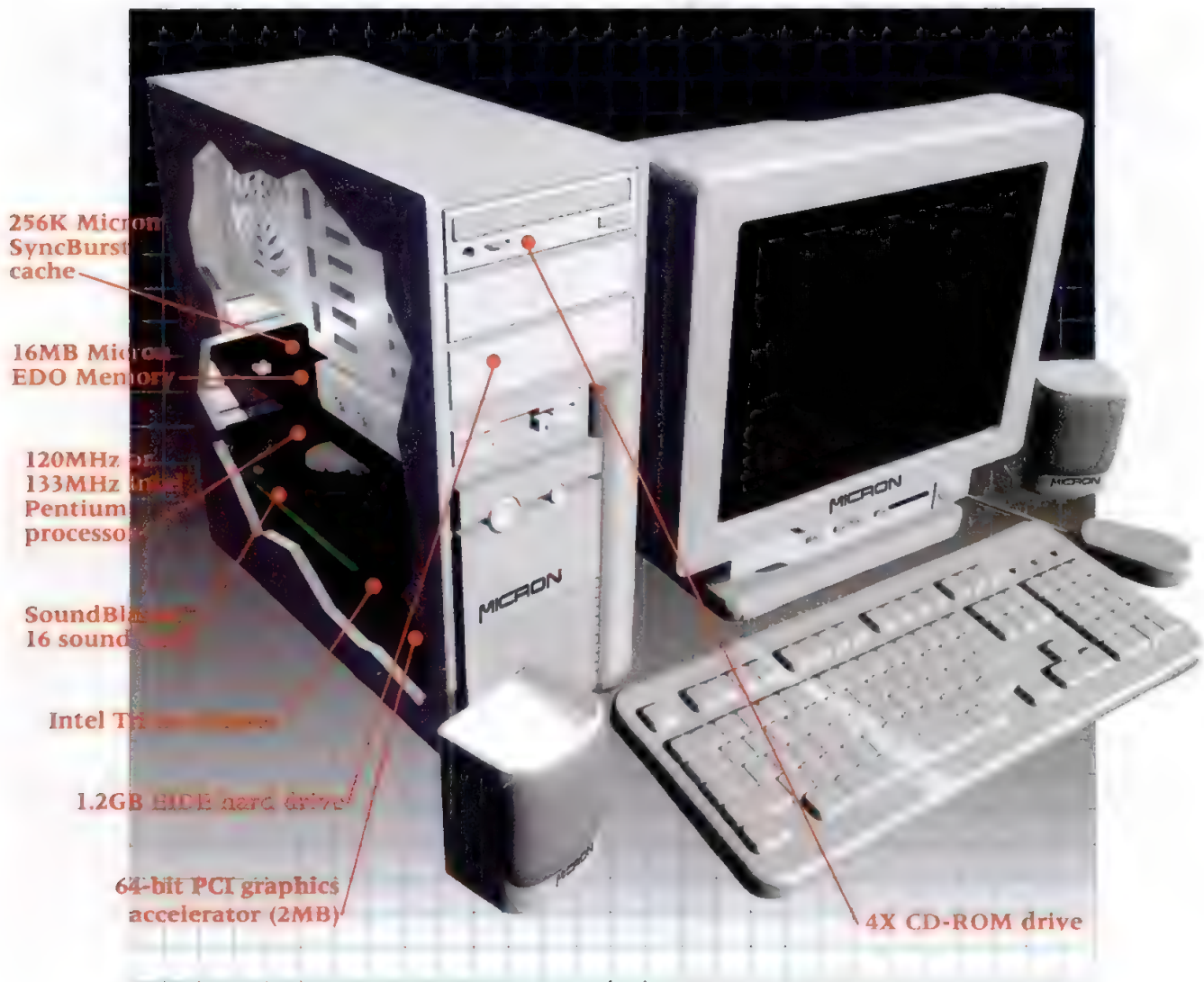
In the flight simulator *Zone 5* running on the Nvidia chip, you can maneuver at 180 degrees, and the whole screen will move slowly.



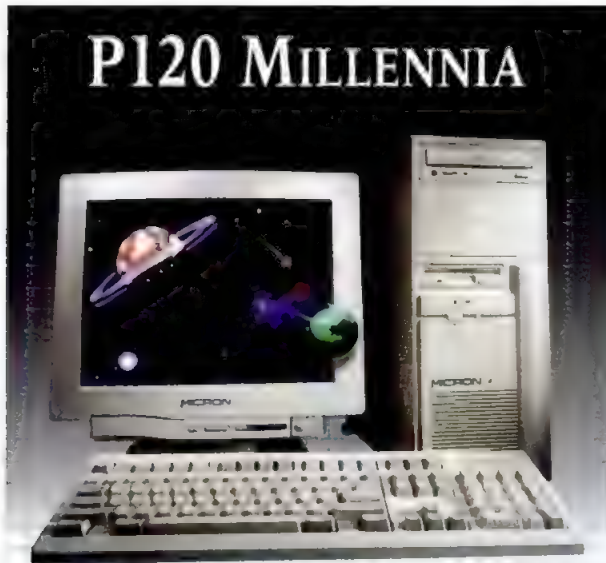
Nvidia takes less horsepower to render and manipulate realistic 3-D objects than existing 3-D technology.

graphics chip set that will show up in graphics cards next year. While standard graphics cards can draw about 100,000 polygons per second, the Lockheed Martin chip set can reportedly draw 750,000 polygons per second. The first cards will cost about \$2,000. —Carol Levin

PC MAGAZINE DEFINES THE PERFECT PC.



MICRON D



P120 MILLENNIA

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May 30, 1995
P120 MILLENNIA

"The Millennia is nothing short of the best all-around PC available on the market today."

PC Magazine, May 30, 1995



P90 POWERSTATION

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- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
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- MS Office Pro 4.3 & Bookshelf CDs

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June 28, 1994
P90 POWERSTATION

"The system's components and general design dazzled under Windows."

PC Magazine, June 28, 1994

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- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups
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"The Micron is without question our dream system from a hardware point of view."

PC Magazine, May 16, 1995



May 16, 1995
P90 HOME MPC



THE PERFECT ENTRY-LEVEL SYSTEM

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- 4X EIDE CD-ROM drive, 3.5" floppy
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- 14" Micron 14FG, 1024NI, .28mm
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

PCs

At 133 MHz, How Powerful Are the Newest Pentiums?

Intel's Pentium processor just got faster. The four systems we review here—from AT&T, Dell, Gateway, and Micron—are the first we've seen with the new 133-MHz Pentium CPU. With a wide range of features and a wide price range, too (from \$3,799 to \$6,375), these are not only the best performing systems we've seen, but they provide something for every computer user.

The 3.3-volt 133-MHz Pentium CPU stands at the pinnacle of PC performance—at least for now. Its power will be eclipsed by a 150-MHz Pentium version later this year and then by the first of Intel's P6 family, which is expected this fall.

In the meantime, Pentium/133 systems will be the top-performing PCs you can buy. The four PCI-based systems we tested delivered benchmark scores about 13 percent higher than the aver-

age of 120-MHz Pentium PCs we've tested.

Dell's Dimension XPS P133c is the hands-down performance leader of the group, and at \$3,799, it's the least expensive. The Micron P133 Millennia is a half-step behind the Dimension in overall performance and has a higher price tag but offers a six-speed CD-ROM drive as standard equipment. Gateway 2000's P5-133XL includes the only multi-CD disk changer. AT&T's Globalyst 730 provides the best

telephony integration we've seen in a PC.

AT&T GLOBALYST 730

If you need a well-designed business communications tool, the AT&T Globalyst 730 is the way to go—but this choice isn't without sacrifice. The \$6,375 Globalyst costs about \$1,900 more than the next-highest-priced Pentium/133 system in this mini-roundup, and its performance isn't up to par.

The Globalyst comes in a case that can be set up either as a mini-tower or a desktop system. The two internal and four external drive bays slide out for

Continues on page 38



PHONE PC: The Globalyst 730's telephony and audio abilities make it the choice for a communications workstation.

The system's integrated volume control (inset) is convenient.

OPERATING SYSTEMS

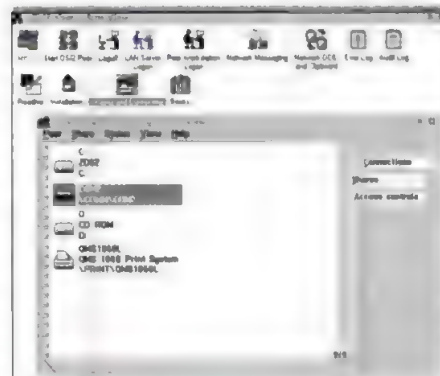
IBM's OS/2 Warp Connect Gets You In Touch with Your Peers

By Steve Rigney

If OS/2 Warp is appearing on your corporate PCs, you'll be glad to learn that IBM has added built-in networking features to its flagship desktop operating system. OS/2 Warp Connect is the first mainstream operating system designed to automate and control your access to a wide variety of networks as well as to the Internet. The \$215 Warp Connect package successfully made contact with a variety of networks we tested it with, but at times its performance was disappointing.

Warp Connect's networking options include connectivity with other Warp Connect or Windows machines, as well as connections to NetWare, OS/2 LAN Server, and NT servers. Also included are IBM's LAN Distance for remote connections and Lotus Notes Express. The Internet Access Kit, which originally shipped with OS/2 Warp 3.0, gives Warp Connect the following Internet tools: IBM's Web Explorer, Gopher, a

The most exciting feature of Warp Connect is its built-in support for a heterogeneous peer network. With Warp Connect, you can share resources with other PCs running Warp Connect, Windows for Workgroups, and Windows NT networks; the program also was able to connect to the latest beta of Windows 95. The peer network is useful if you want to establish individual workgroups on your corporate LAN or if you want to share files and printers in a small office.



ALL FOR ONE AND ONE FOR ALL: Warp Connect's Sharing and Connecting utility allows the sharing of disk drives, printers, CD-ROM drives, and communications ports.

news reader, an ftp client, and a telnet terminal.

The Warp Connect package includes a full version of OS/2 Warp and the Win-OS/2 extensions for running Microsoft Windows within Warp. This summer IBM will also offer a limited version of Warp Connect that will work with your existing version of Windows.

HARD TO FIND

The only problem we found with the peer services was the in-

ability to see or browse the other peer servers on our network. While the Warp Connect peer services can successfully browse other Warp Connect servers, if you want to network to a Windows for Workgroups or Windows NT server, you must know the name of the server and the

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First Looks

133-MHz Pentium PCs

Continued from page 37
easy access and maintenance, and they can be rotated 90 degrees; the CD-ROM drive works horizontally or vertically.

AT&T integrates the S3 968 graphics chip and Sound Blaster audio circuitry on the mother-

board, so all the system's slots are available. The Globalyst can accommodate dual processing, although the companion CPU that you'll need isn't yet available.

The Globalyst's 2GB Seagate Barracuda hard disk comes loaded with powerful communications utilities, including Vistum Share document conferencing; MailFlash and MessageFlash e-mail forwarding software for alphanumeric pagers; Network Central for virtual file management; and Note-IT!, a screen

saver that lets people leave written or spoken messages on your computer while you're away from your desk. To support Note-IT!'s audio functions, the Globalyst's sound system features integrated speakers, a microphone, and a convenient volume control on the system's front panel. The test system came with external speakers as well.

The Globalyst's weak point is performance. The system's Winstone 95 score of 193 was about 10 points below the average and matched that of the Gateway P5-120 (reviewed in "Tapping the Promise of the Pentium," May 30, 1995). Two culprits are to blame: the combination of an Intel motherboard and VLSI chip set (the other Pentium/133s used the Triton chip set) and the Globalyst 730's use of standard DRAM memory chips instead of EDO DRAM. On the positive side, the Globalyst 730 is the only one of the four to support parity-checking memory.

We also tested the Globalyst with a prototype 1MB external cache module. But even with this \$616 option, the system could not break the 200 mark on Winstone.—Jodi L. Wynblatt

AT&T Globalyst 730. List price: With Pentium/133 CPU, 16MB RAM, 256K external cache, 2GB hard disk, 17-inch monitor, CD-ROM drive, \$6,375. AT&T Global Information Solutions, Dayton, OH; 800-447-1124, 513-445-5000.

Circle 430 on reader service card

DELL DIMENSION XPS P133c

The Dell Dimension XPS P133c delivers superior Windows performance and blazing graphics for the hard-to-beat price of \$3,799. The least expensive system reviewed here, the Dimension posted several record scores and comes fully equipped.

The 133-MHz Dimension uses Intel's motherboard and Triton chip set, but rather than offering 256K of external cache soldered onto the board, the Dimension that we tested came with 512K of external cache—the largest processor cache of this group. The only drawback to this module, however, is that it blocks one of the system's four PCI slots.

Dell targets this PC at small and midsize business users, as well as experienced home users. With a Winstone 95 score of 207, a Graphics WinMark 95 result of 23 million pixels per second, and a CPUmark₁₆ score of 289—all records—this system should not disappoint either audience. The only area where the Dimension seriously stumbles is DOS Video performance. This is due to the system's Number Nine Imagine 128 graphics card, which uses the Diamond Stealth 64 video chip, a notoriously poor DOS performer. But unless you plan to use the Dimension strictly as a place to play DOOM or other DOS games, this shouldn't present a problem.

The Dimension is in a mini-tower case. Inside the test system was a 1GB Quantum Fireball hard disk and a quad-speed IDE CD-ROM drive. Dell rounds out this package with a Creative Labs



DISK SWAPPER: The Gateway 2000 P-5 133XL's three-disk CD changer (inset) makes working with large data sets easier.

Vibra16 sound card, a U.S. Robotics Sportster V.34 modem, and a 17-inch monitor. Dell excels at the little things as well: There are small handles on all jumpers that make it easier to switch settings, and the shrouds that cover the system's IDE cables help keep the inside of the case free of tangled wires.

Dell's Dimension XPS promises top performance at a low price and delivers on both scores.

—Carol Venezia

Dell Dimension XPS P133c. List price: With Pentium/133 CPU, 16MB RAM, 512K external cache, 1GB hard disk, 17-inch monitor, CD-ROM drive, \$3,799. Dell Computer Corp., Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320.

Circle 431 on reader service card

GATEWAY 2000 P5-133XL

The \$4,299 Gateway 2000 P5-133XL is the latest, most powerful iteration of the Editors' Choice-winning P5-120 and P5-100XL systems (May 30, 1995), and it doesn't disappoint in terms of features and performance.

The P5-133XL's laundry list of high-end equipment includes a component yet to be offered by any other PC vendor as standard equipment: a quad-speed CD-ROM drive with a three-disk changer. This Sanyo drive uses a three-CD magazine similar to those found in car or home audio systems. While the changer takes several seconds to swap disks, it is faster and easier than manually changing disks and is a must-have device for those who use a lot of CD-ROMs. Rounding out the P5-133XL's multimedia abilities are



OVERACHIEVER:

Thanks in part to its 512K external cache module (inset), Dell's Dimension XPS P133c was the performance leader of the group.



BENCHMARK TESTS



133-MHz Pentium PCs

The Dell Dimension XPS P133 led this group of four 133-MHz Pentium PCs, setting records on the Winstone 95, Graphics WinMark 95, and CPUmark₁₆ tests. This showing was balanced, however, by poor DOS results. The Gateway P5-133XL and Micron P133

Millennia produced similar scores, with the edge going to the Micron system. The AT&T Globalyst 730 was generally at the rear of this group on the Windows tests but excelled on the DOS tests.

We used WinBench 95, Version 1.0, and PC Bench, Version 9.0, to gauge the performance of these desktop PCs. Each system was equipped with 16MB of RAM.

Higher scores represent better performance.

Red type denotes first place.

	Winstone 95	Graphics WinMark 95 (Mpixels/sec)	Disk WinMark 95	DOSMark	CPUmark ₁₆	DOS Video	DOS Disk
AT&T Globalyst 730	193	21.1	1,230	1,381	281	4,442	1,077
Dell Dimension XPS P133	207	23.0	1,070	978	289	1,518	995
Gateway P5-133XL	201	20.1	968	1,353	285	4,978	950
Micron P133 Millennium	207	22.6	1,010	1,391	286	5,356	989
Pentium/120 average (May 30, 1995)	179	17.8	873	1,180	254	4,276	863

First Looks

an Ensoniq SoundScape wave-table audio board, a three-piece Altec Lansing ACS-31 speaker system, and a 17-inch Vivitron monitor, which uses a Sony Trinitron CRT tube.

Under the full-size tower's cover you'll find ample room for future expansion. The heart of the system is an Intel-made motherboard that has 256K of external cache and EDO memory.

In one of the system's three PCI expansion slots, you'll find an ATI Mach 64-based graphics accelerator board with 2MB of VRAM. For data storage, the Gateway PC uses a Western Digital 1.6GB hard disk.

This combination of components yielded competitive scores on our Windows-based benchmark tests. The PC's Winstone 95 and Graphics WinMark 95 scores were slightly lower than the top scores posted by the Dimension. On our Disk WinMark 95 tests, however, the P5-133XL's score lagged behind the pack and approached the level of a 120-MHz Pentium system.

While it is neither the least expensive nor the best performing 133-MHz Pentium system available, the Gateway P5-133XL is an excellent value.—CV

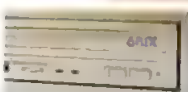
Gateway 2000 P5-133XL. List price: With Pentium/133 CPU, 16MB RAM, 256K external cache, 1.6GB hard disk, 17-inch monitor, CD-ROM drive, \$4,299. Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.

Circle 432 on reader service card

MICRON P133 MILLENNIA

A well-made, fully-equipped computer that recently won an Editors' Choice award (May 30, 1995), the Micron Millennium just got better and faster. The \$4,498 Micron P133 Millennium system was just behind the blistering pace set by the Dell Dimension and offers a unique mix of high-end features.

New to the P133 Millennium is the Plexor 6PleX six-speed CD-ROM drive, which uses a Future Domain SCSI adapter card; the other systems reviewed came with IDE-based quad-speed CD-ROM drives. The P133 Millennium



SIX SPEED: The Micron P133 Millennium's use of a six-speed CD-ROM

drive (inset) brings data to the screen quicker.

also includes a Western Digital 1.6GB hard disk, Micron-made EDO memory chips, 256K of external cache, and a Diamond Stealth 64 video card with 2MB of VRAM. Multimedia-ready, the P133 Millennium uses a Sound Blaster 16 audio card, Koss speakers, and a 15-inch monitor.

The unit garnered some of this roundup's best scores on our benchmark tests. The P133 Millennium's Winstone 95 result of 207 tied with the Dell Dimension, but it was slightly off the mark with a 22.6-million-pixel-per-second Graphic WinMark 95 result; the

P133 Millennium had the top DOS-Mark score of 1,391.

The Micron P133 Millennium is one of the best PCs on the market today. And like its now-slower siblings, the P133 Millennium offers quite a bang for the buck.

—Tin Albano

Micron P133 Millennium. List price: With Pentium/133 CPU, 16MB RAM, 256K external cache, 1.6GB hard disk, 15-inch monitor, CD-ROM drive, \$4,498. Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-463-3434; fax, 208-465-3424.

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PORTABLE PCs

IBM's ThinkPad 755CV Projects a New Image

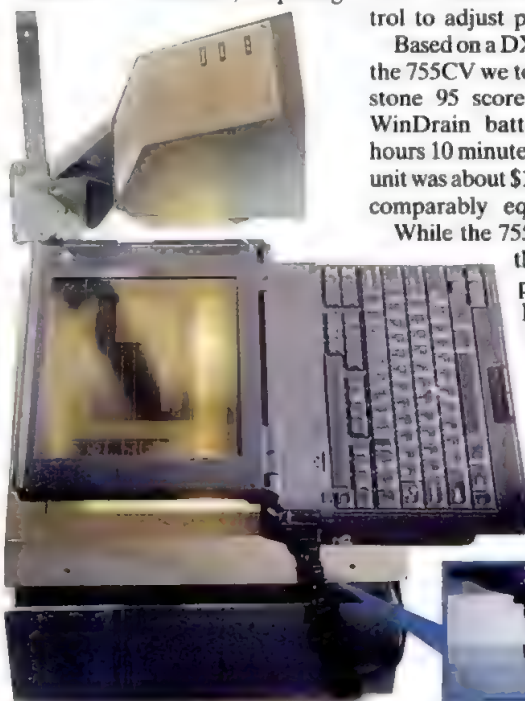
By Brian Nadel

Like a Transformer toy, IBM's ThinkPad 755CV folds open to reveal a new personality—a notebook whose lid can be removed so that it can work with an overhead projector. At \$6,799, the 755CV is expensive, but it lets you give a group presentation at the spur of the moment.

The 755CV's quick change starts when you unsnap its lid and fold the hinge over. In an arrangement that would have made Rube Goldberg proud, the 755CV is then strapped to an overhead projector. It takes about 5 minutes to set up the unit and lock the system's seat belt in place (with its straps secured, the PC remains precariously perched on the overhead projector). The hardest part is positioning the notebook's display panel so that it is exactly parallel to the overhead projector's glass bed—necessary if the entire screen is to be in focus.

The 755CV only works with transmissive projectors, and if you use one whose output is above 6,000 lumens, the panel may temporarily overheat and turn brown. While you can't write directly on the panel, IBM provides the next best thing to annotate your presentation: Mind Path Technologies' Presentation F/X infrared (IR) remote control (First Looks, September 13, 1994), which can beam commands to the ThinkPad's built-in IR window. Included special effects software gives you the ability to circle or under-

line portions of a slide and even write notes. With the 755CV's cover in place, however, the IR window is obscured, requiring



FOLD-OUT SCREEN: The lid of the ThinkPad 755CV folds over to work with many common overhead projectors, but the notebook requires a safety strap to stay in place.

contortions to maintain a line-of-sight connection between the remote control and the notebook.

The 7-pound-6-ounce system has the same keyboard, TrackPoint III pointing stick, 10.4-inch active-matrix color display, dimensions, and weight as a 755C

model. The display is bright and rich, although at times it appeared slightly dulled compared to the 755C. There's a single slide control to adjust panel brightness.

Based on a DX4/100 processor, the 755CV we tested had a Winstone 95 score of 53.4 and a WinDrain battery result of 2 hours 10 minutes. At \$6,799, this unit was about \$1,400 more than a comparably equipped 755CE.

While the 755CV works well, the strap-on approach is still lacking. This PC is only for those who lug around a notebook and an external projection panel and want to lighten their load.

ThinkPad 755CV. List price: With DX4/100 CPU, 8MB RAM, 540MB hard disk, 10.4-inch active-matrix color display, \$6,799. IBM Personal Computer Co., Somers, NY; 800-772-2227; fax back, 800-426-4329 (enter 99).

Circle 434 on reader service card

OS/2 Warp Connect

Continued from page 37

name of the shared resources you want.

Establishing a connection to a peer network is accomplished by selecting the Connection tab from the Peer Services icon and typing in the name of the server and your user name and password. Once you're attached to the server, you can use Warp Connect's Sharing and Connecting utility to map drive letters and printer ports to the server.

We were glad to see the inclusion of 32-bit NetWare and LANServer requesters in Warp Connect. We installed both the LANServer and NetWare requester and simultaneously logged on to NetWare 3.12, NetWare 4.1, and LANServer 4.0 file servers. But Warp Connect can't process your NetWare login script, so you will have to use the NetWare Tools utility to map the network's printers and drives manually.

The NetWare requester included with Warp Connect allows you to access the NetWare Directory Services (NDS) on NetWare 4.x networks, but the NDS access is disabled when you install the product, and you must edit your NET.CFG file and reboot your PC to access an NDS server. While this is not a problem for a network administrator, it isn't fully documented, and we had to contact IBM technical support before we could successfully access the NDS tree on our NetWare 4.1 server.

LOG ON...LOG OUT

With access to all of these networks, it could take you 10 minutes just to log on using the different prompts and menus. Fortunately, Warp Connect includes a unified log-on utility called Network Sign-on Coordinator that lets you use a single user name and password to access all the file and print servers.

The only remote-access feature that Warp Connect includes is



PASSING NOTES: The built-in Network Messaging program lets you easily send short notes to other users on the network.

IBM's LAN Distance Client Software. While you can establish a remote-node connection to a LAN Distance server running the TCP/IP, IPX, and NetBEUI protocols, you can't connect to other popular remote-node servers such as Novell's NetWare Connect. Later this summer IBM will offer client software for Shiva access servers.

While we found it was fairly easy to access all of the different networks using the included utilities, we were concerned with Warp Connect's network performance. When we used the Network icon to view the available network resources, it took several seconds to move between subdirectories and drives. But when we mapped a drive letter to the same

curved on multiple PCs attached to different networks. Be prepared to wait a few seconds for a simple network or several minutes for a complicated LAN.

The next step is for IBM to expand the abilities of Warp Connect by including a mobile file synchronization system, 3270 emulation, a performance monitor, and a DCE client; expect the upgrade this summer.

INSTANT NETWORK

Warp Connect is built around an automatic installation program that IBM claims can successfully detect your LAN hardware and invisibly configure and deliver a working network. But sometimes the technology gets in the way.

We installed Warp Connect on a Zenith Data Systems Z-Server EX P90E, a Z-Server 433DE, and an ALR PowerVEISA client PC equipped with 3Com 3C509 Ethernet adapters. Our problems started when the installation process couldn't detect the node address of our Ethernet cards. After we manually configured the node address using the Connect MPTS (Multi-Protocol Transport Service) utility, the PC successfully connected to our NetWare file server, but the peer services would not work.

The 3Com cards have a feature that attempts to regulate the flow

of data within the PC, but you have to enter the modem speed in the LAN card's configuration. The Warp Connect peer services would not work if the 3Com adapters were configured for a data throughput of higher than 9,600 bits per second. There was no indication of a problem in our documentation or the README file, and the same cards worked fine with other desktop and network OSs, including Windows for Workgroups, Windows 95, Windows NT, and NetWare. IBM technical support is working on the problem.

Warp Connect's minimum configuration requires a 386 CPU, 8 to 12MB of RAM, and 90MB of hard disk space. We found that if you want acceptable performance, you really need a 486DX2/66 PC with 16MB of RAM. You'll also want to use a network adapter that works with Warp Connect.

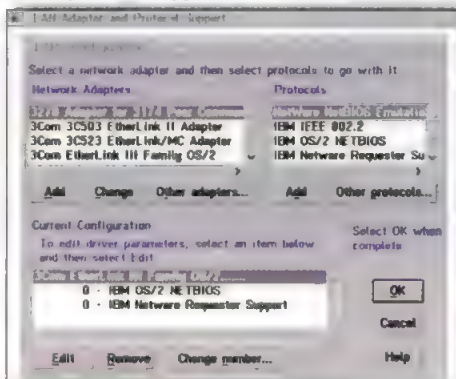
Warp Connect comes on a CD-ROM and requires about 30 minutes to install. After you have installed Warp Connect on one PC, you can create boot disks for installing the OS on your other clients across the network. The network installation is much faster, especially if you are upgrading several PCs.

The features built into Warp Connect will make it a lot easier to connect your OS/2-based PC to the network. The peer services are extremely flexible and the integrated client requesters will connect you to two of the

most popular server-centric networks on the market. Until IBM smoothes out Warp Connect's compatibility problems and its sluggish network performance, however, you may want to consider Artisoft's LANtastic for OS/2 or wait for Warp Connect's next release.

OS/2 Warp Connect. Estimated street price: \$215. Requires: 8MB RAM (16MB recommended), 90MB hard disk space, CD-ROM drive. IBM Corp., Armonk, NY; 800-342-6672; fax-back, 800-342-6672 (enter 99).

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SET-UP CONTROL: The MPTS utility lets you add, remove, and configure all of the network adapters and protocols from your PC.

resources, we were quickly able to access the network using either a command prompt or the graphical Drives utility. This problem oc-

FIRST LOOKS PLUS

From July 17 through 21, go online to discuss OS/2 Warp Connect with IBM's Art Oilbert, VP, Network Operating Systems, and reviewer Steve Rigney. Type GO EXEC at any CompuServe! prompt.



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INTERNET ACCESS

Netscape Navigator 1.1N Sails Around the World-Wide Web

By Greg Pastrick

Stop using whatever Windows Web browser you currently have and download Netscape Communications' Navigator ([ftp://ftp.netscape.com/netscape1.1/](http://ftp.netscape.com/netscape1.1/)). Built for security, speed, and streamlined handling of even the most complicated on-line pages, the Netscape Navigator 1.1N is an even more powerful version of a product that was already one of our favorites. Available for a free 30-day trial and priced at \$39, Netscape's Navigator Web-browser is the current Internet bargain.

Like Version 1.0, Navigator 1.1N is optimized for use at low bandwidth 14.4-Kbps connections. This means Navigator screams through the bytes when loading documents and images via faster modem and network connections. Neither Navisoft's InternetWorks Beta 7 nor NCSA Mosaic 2.0.0b4 can touch Netscape's efficient loading of graphics-rich Web pages. Its disk and RAM caching also help to load large files quickly.

With one or two exceptions, Navigator's browser interface and tools surpass those that you will find in the latest releases of InternetWorks or NCSA Mosaic. For example, a right mouse click on any hypertext link launches a menu so that you can open or save a bookmark, copy the location of the link, page-jump forward and back, or pull up the full Bookmark List. The pop-up history list—along with hierarchical editing features on the Bookmark List—keeps a sensible log of where you have already been on the Net and how to return to where you started.

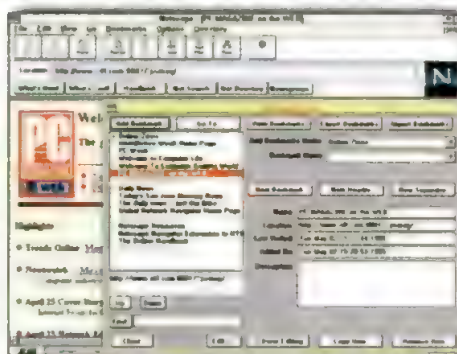
Navigator 1.1N is equally no-

table for its Multi-purpose Internet Mail Extensions (MIME) support, its handful of native viewers, its excellent newsgroup filters, and its similar look and feel across all platforms.

The browser's true strength, however, lies in its enhanced features, which are designed around Netscape's Secure Sockets

Layer (SSL) protocol, its open APIs with two-way support for a variety of media types, its use of HTML 3.0 tables and graphical backdrops, and its dynamic document updating.

The Netscape SSL technology that's built into Navigator (as well as the company's \$5,000



BOOK KEEPING: Hierarchical bookmarking lets you quickly annotate, reorder, and label your hot resource listings.

Commerce Server software) points the way to business on the Web. SSL authenticates the secure server, encrypts data, and maintains message integrity as long as it's in place on both ends of the on-line link. During our testing of Netscape's browser, we tried to send some forms-

based data to a non-SSL server and Navigator displayed a warning on the screen.

Navigator 1.1N's features (such as the Netscape Client API, or NCAP, and dynamic document updating) will challenge third-party developers and content providers to come up with new ways of handling and delivering on-line content. Using the NCAP protocol, developers can create more Web-aware apps.

A fast and efficient tool that is clearly head and shoulders above other Internet browsers, Netscape Navigator 1.1N can bring more of the Internet to your desktop—and bring it there faster.

Netscape Navigator 1.1N. List price: Free for 30-day evaluation; \$39 to register. Requires: 8MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Netscape Communications Corp., Mountain View, CA; 415-528-2555; fax, 415-528-4121; Web, <http://home.netscape.com>. Circle 403 on reader service card

SOFTWARE

Lotus ScreenCam 2.0: Subtitled for Your Convenience

By Kevin Reichard

Moving beyond its original role as software that merely recorded Windows screen activity, Lotus's \$99 ScreenCam for Windows Release 2.0 adds captioning and increased Lotus Notes connectivity. It is now an essential tool for corporate users and multimedia presentation developers.

ScreenCam 1.0 let you record whatever you wanted within the Windows environment and add narration. ScreenCam 2.0 does that one better, letting you add captions to these PC-based movies. You can place editable captions on any portion of the movie or set up the captions first and then record the movie to match the words.

Any Windows font can be used for the captions, and the captions can be saved and reused. A set of included backgrounds lets you vary the presentation's look. Throw in the ability to insert a corporate logo and ScreenCam 2.0 is useful

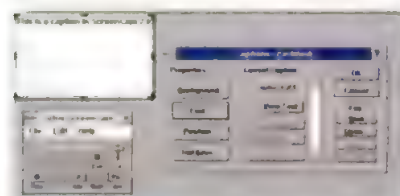
for everything from adding a little flair to a basic presentation to building software product demonstrations.

Captioning can work in sync with voice narration, but many users will want to use it as a substitute instead, as text-based captioning takes up much less disk space than audio recording.

A ScreenCam movie with voice narration once occupied 1MB of disk space per minute of movie; with captioning instead of voice narration, you can fit a 15-minute movie into a little more than a megabyte of hard disk space.

ScreenCam 2.0 contains a set of fields for automatically inserting a movie into a Notes form and automatically archiving a movie into a designated Notes database. And you can track the authorship and length of a ScreenCam movie through a Properties dialog box.

Another change that current ScreenCam users will appreciate is



MOVIE SUBTITLES: ScreenCam 2.0 lets you add captions as well as narration.

the ability to edit movies. In the past, movies needed to be rerecorded from scratch if changes were desired, even if you only wanted to change a few keystrokes and leave the sound intact. With Version 2.0, you can change the existing screen capture or the narration, or both. On the other hand, ScreenCam 2.0 doesn't support 256 colors or higher color depths.

ScreenCam 2.0, as easy to use as its first incarnation, gives you increased functionality and integration with the Notes environment. **Lotus ScreenCam for Windows Release 2.0.** Estimated street price: \$99 (upgrade, \$49). Requires: 4MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later. Lotus Development Corp., Cambridge, MA; 800-343-5414.

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From July 10 through 14, you can go on-line to discuss NetScape and the Internet with VP of Technology and cofounder of NetScape Communications Marc Andreessen and reviewer Greg Pastrick. Type GO EXEC at any CompuServe prompt.



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CAD

AutoCAD LT: A \$495 All-Purpose Design Tool

By Will Schleter

Autodesk's second release of AutoCAD LT for Windows, its low-end Windows-based CAD program, continues to appeal to those who don't want—or need—all the bells and whistles of the company's \$3,995 flagship AutoCAD program (First Looks, February 21, 1995). The \$495 AutoCAD LT is easier to learn and use and can get new users quickly up to speed. Experienced users will find much of the program unchanged but will appreciate refinements such as the new hatching tool and better plotter support. Those who use AutoCAD LT in conjunction with AutoCAD, however, will be disappointed by the awkward handling of AutoCAD Release 13 files in the LT version.

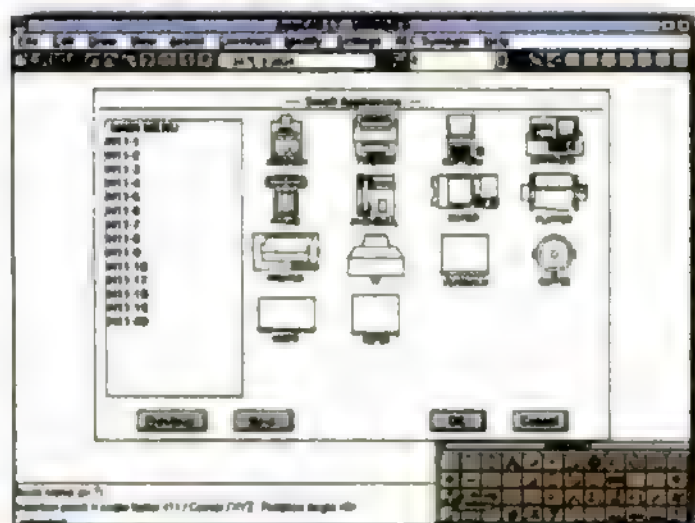
2-D WORKHORSE

For many, the full version of AutoCAD is expensive overkill for performing common 2-D drafting tasks. AutoCAD LT is a relatively low-cost program that includes AutoCAD's most popular tools and features. The good news is that the interface continues to be the same on both programs. The bad news is that AutoCAD LT still uses an odd combination of graphical elements (like customizable toolbars) and still relies on the command line.

AutoCAD LT leaves out such high-end features as AutoCAD's AutoLISP programming functionality, independent developer applications, digitizer support, OLE client capability, import of PostScript and raster files, fully functional 3-D drafting, and solid modeling. Those running AutoCAD LT on a network will have to do without the SQL database links included in the full product but can run AutoCAD LT on a server while maintaining

personal workstation configuration files.

An important trait of AutoCAD LT is its file compatibility



LIBRARY CARD: AutoCAD LT's optional libraries each hold over 1,500 symbols.

with the full-scale AutoCAD program—that is, with one glaring exception. While you can freely exchange files between Release 12 of AutoCAD and AutoCAD LT, you are limited where Release 13 is concerned. We found that in order for AutoCAD LT to be able to open an AutoCAD Release 13 file, the file must have been saved with AutoCAD's SAVEASR12 command. This severely limits the usefulness of AutoCAD LT in a mixed environment, and it's a big disappointment.

AutoCAD LT has outwardly changed little, but it's improved for those who have spent lots of time tediously defining complex

screen pick. The hatching is truly associative, so that as the boundary changes, so does the hatching.

Other new or enhanced features include quick and custom setup options, standard drawing formats, ToolTips to give you a fly-by text description of each toolbar icon, direct distance entry, divide and measure commands, and dialog-box-based entity modification. Longtime AutoCAD LT users will appreciate the program's direct HPGL plotter support, as well as its faster and more reliable general printing.

AutoCAD LT fails to provide enough predefined symbols. Starting with Release 2, Autodesk will sell optional symbol libraries to fill the gap. The first three sell for \$99 each and cover architectural, mechanical, and electrical symbols. Each library includes over 1,500 symbols of everything from a coffee pot to a variety of wires and plugs. Installing one of the libraries adds an additional choice to the AutoCAD

LT menu that opens a straightforward point-and-click graphical interface to select and place the symbols on your drawing.

Since AutoCAD LT retains the aging AutoCAD user interface, it's not as easy to use as other Windows-based CAD packages. Still, it does an excellent job of handling graphics-intensive design chores. While AutoCAD LT is intended primarily for 2-D work, it offers some rudimentary 3-D capabilities such as specifying the depth and thickness of objects, viewing objects from any orientation, and allowing you to generate shaded and hidden-line-removed views. You can incorpo-

rate multiple viewports into a single drawing, but AutoCAD LT still allows only one drawing to be open at a time.

Microsoft Windows 3.1 is the only explicitly supported operating environment for AutoCAD LT, but the package can be used with OS/2, Windows NT, and Windows 95. Autodesk has no plans at this time for a DOS or Macintosh version.

HELP ON THE WAY

AutoCAD LT has a user guide that doubled in size from Release 1 to Release 2 and now includes many useful time-saving examples. The program also includes on-line help, cue-cards, and application-specific tutorials you can turn to should you get in over your head. Autodesk provides fax, mail, and CompuServe support free of charge, along with 90 days of included phone support. Continuing phone support costs \$2 per minute (an unlimited-support contract costs \$149 a year).

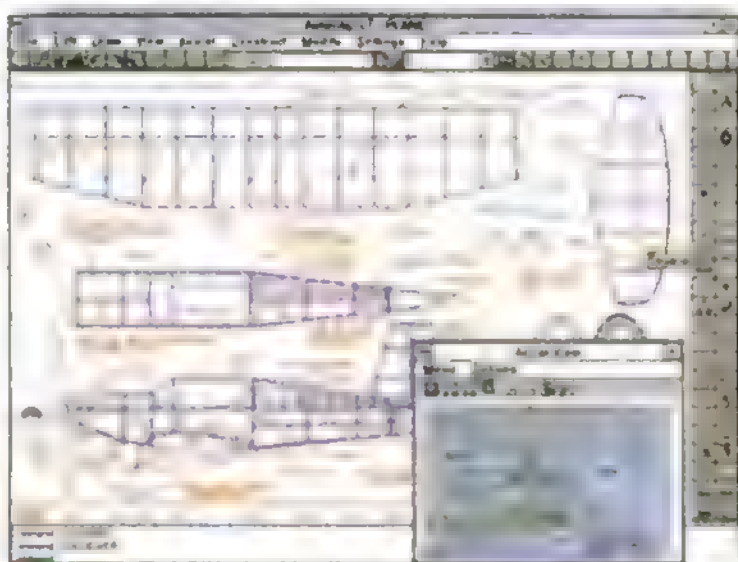


OVERHEAD: The Aerial View window lets you look at any drawing from another perspective.

There are many excellent low-cost Windows CAD systems available, some of which cost hundreds of dollars less than AutoCAD LT. But if you want the familiarity and security of a true AutoCAD-based application, then AutoCAD LT Release 2 is the only way to go.

AutoCAD LT Release 2 for Windows. List price: \$495; upgrade from Release 1, \$99; symbol libraries, \$99 each. Requires: 8MB RAM, 16MB hard disk space, Microsoft Windows 3.1 or later. Autodesk Inc., San Rafael, CA; 800-435-7771, 415-507-5000; fax, 415-507-5595.

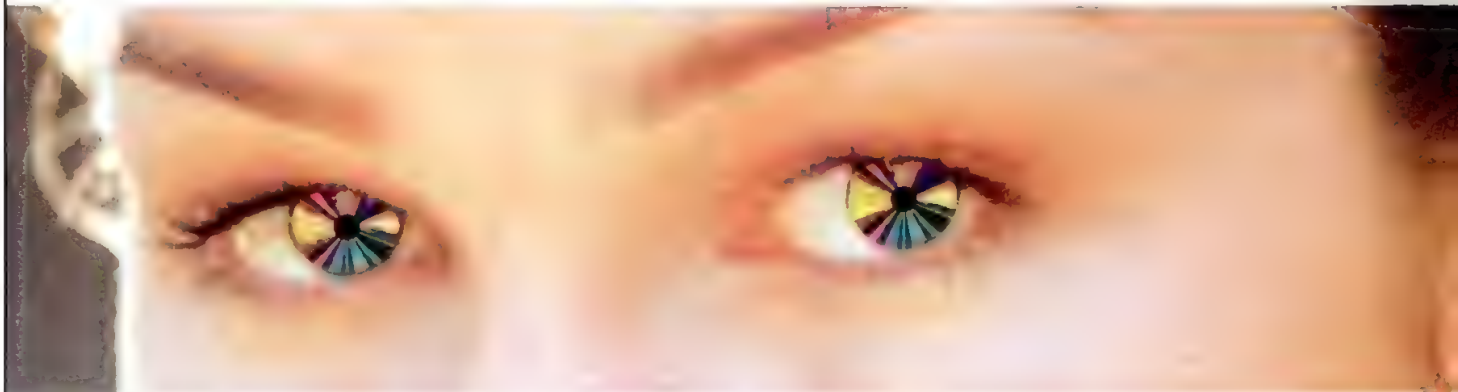
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FLY BY: AutoCAD LT's customizable toolbar and floating toolbox augment the command line.

cross-hatching boundaries of drawings. Release 2 of AutoCAD LT includes a boundary hatching tool that lets you specify an entire area to be hatched with a single

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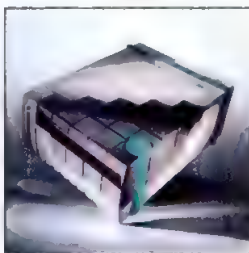
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The Sierra 1.3 GB is the industry's fastest optical drive. It can be used as both a hard disk replacement and an on-line archiving system. Each 5.25" cartridge holds 1.3 Gigabytes of data, and boasts a 30-year shelf life. It is ideal for data-intensive applications such as graphics, CAD/CAM, multimedia or data archiving. **\$2,495**

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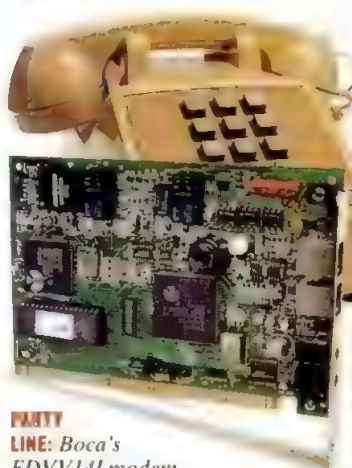
MODEMS

Boca's 14.4-Kbps Modem Does Double Duty on One Phone Line

By Winn L. Rosch

Thanks to today's communications technologies, your office needs three telephone lines: one for your phone, one for your modem, and one for your fax machine. Using Radish Communications' VoiceView technology, Boca Research hopes to cut at least one of these copper cords. Its \$154 14.4Kbps Multimedia Voice Modem with VoiceView (also called the FDVV14I) enables voice and data to share a single line.

Like other Boca modems, the FDVV14I is easy to install, comes with good software (FaxWorks), and performs well. The unit combines—on a half-length PC expansion board—a V.32bis/V.42/V.42bis data and EIA Class 2 fax modem with voice-mail support for up to 1,000 password-protected mailboxes. It also supports



PARTY LINE: Boca's FDVV14I modem switches between digital and analog signals on a single line.

Caller ID, fax forwarding and notification, and document retrieval.

Using the VoiceView technology is easy. Load the Radish TalkShop software through Win-

dows and use your telephone to make a phone call. If you're talking to someone who also has a modem equipped with VoiceView, you can exchange files or play games simply by clicking on menu selections inside TalkShop. You don't have to break the voice connection to move data.

For example, when you ask TalkShop to transfer a file, VoiceView automatically switches from voice to data communication. Even the familiar modem hum and hiss of negotiating a data connection is kindly muted during the first few seconds of a transfer.

The VoiceView system, however, steals the line from your conversation when you send a file, and you won't be able to get a word in until your file transfer finishes (given today's graphics-oriented files, that may mean a 5- to 10-minute wait). Moreover, the system doesn't handle errors very well. Hang up in the middle of a data exchange and the transfer dies, with TalkShop posting misleading error messages at each end of the connection.

AT&T offers a similar system called VoiceSpan. Where VoiceView simply switches between digital data and analog voice connections, VoiceSpan *packetizes* your voice and ships it off digitally, interleaving voice and data packets. This approach allows a more equitable sharing of the phone line; voice takes priority so you can talk while transmitting a large file. Rather than cutting you off, VoiceSpan slows the transmission.

On the other hand, VoiceView is much less complex and less expensive. It's an open standard that's cheap to include in a basic modem. Until faster modem speeds (such as 28.8 Kbps) become the standard, Boca's 14.4Kbps Multimedia Voice Modem with VoiceView will be the way to share a phone line. **14.4Kbps Multimedia Voice Modem with VoiceView.** List price: \$154. Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1 or later. Boca Research Inc., Boca Raton, FL; 407-997-6227; fax, 407-997-0918.

Circle 425 on reader service card

DATABASE MANAGEMENT SYSTEMS

Microrim's R:BASE Comes to Windows

By Joe Salemi

Microrim has finally brought R:BASE to Windows. R:BASE 5.0 for Windows (\$495), the latest version of the venerable database management system (DBMS), is a full 32-bit application that's backward-compatible with both the DOS and OS/2 versions of R:BASE 4.5 (an upgrade is \$195) and adds support for graphics in the program's database, forms, and reports. R:BASE 5.0 is resource-intensive, however, and doesn't bring any new capabilities to the increasingly competitive Windows database market.

R:BASE 5.0's main interface is the Object Manager. You use it to access databases and manage tables, views, forms, reports, labels, and applications. The query by example (QBE) interface is accessed through the toolbar or menus. You use the right mouse button to bring up context-sensitive pop-up menus in the

various object designers.

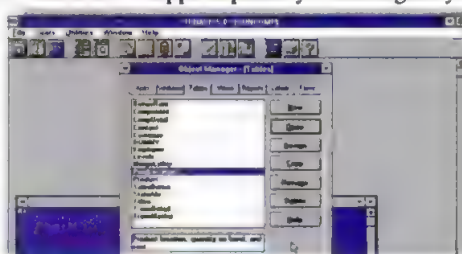
The program still includes the R> prompt, familiar to those who've used the earlier versions.

The R> prompt appears in its own window and lets you directly enter SQL and R:BASE commands. Version 5.0 includes R:BASE's excellent application generator, which makes it easy for nonprogrammers and programmers alike to create sophisticated database applications.

Version 5.0 can share database files and run applications created in Version 4.5. The included conversion utilities can convert databases and applications dating back to R:BASE 4000 to the current format. The program can also directly read and write dBASE III, dBASE III Plus, and

dBASE IV files, as well as indexes that have the .NDX extension.

R:BASE 5.0 also uses SQL with R:BASE extensions as its command language; the built-in SQL is compatible with the ANSI Level 2 standard. The program supports primary and foreign keys



SOMETHING OLD, SOMETHING NEW: R:BASE 5.0 uses the Object Manager as its primary interface but retains the R> prompt.

but uses rules to handle referential integrity, instead of the SQL integrity-enhancement commands.

You can include graphics in the database with the new VARBIT (BLOB) data type and can retrieve them in forms and reports. You can also include graphics directly in the forms and reports for display and printing. Databases and applications that use graphics

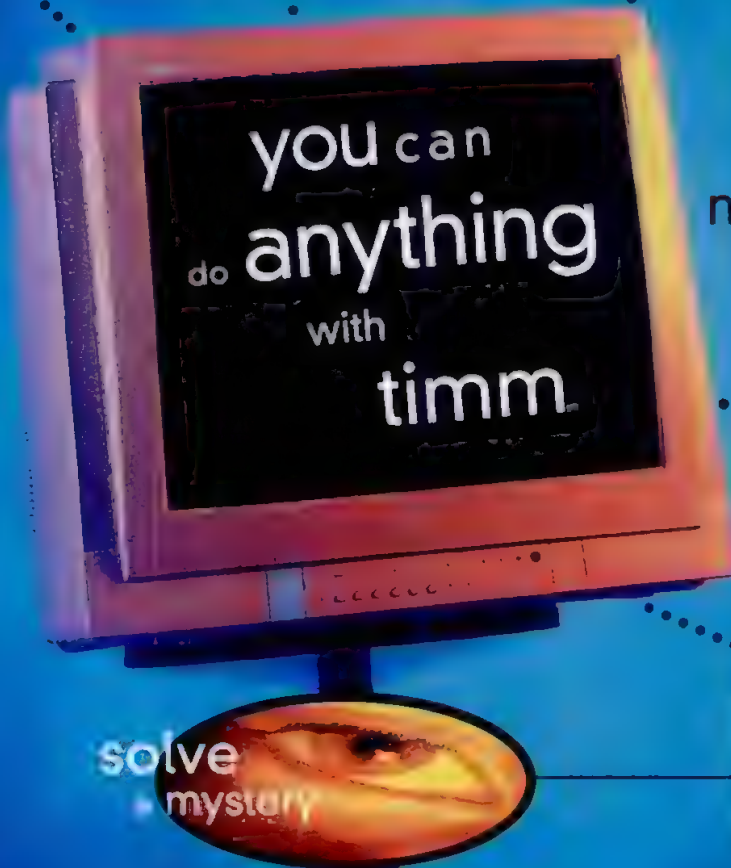
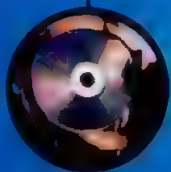
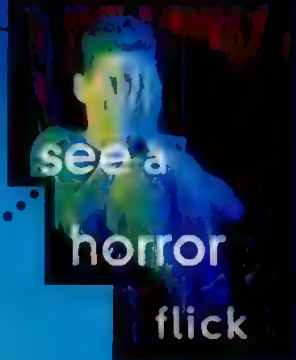
objects can't, however, be used with earlier versions.

In informal testing, R:BASE 5.0's performance came close to that of the DOS versions. We found that the package really benefits from additional memory, so you should give it as much RAM as you can.

R:BASE for Windows 5.0 is a good Windows database, but it doesn't break new ground. You'll like it if you're looking to move from the DOS or OS/2 R:BASE program to a Windows database or if you're looking for a database that uses SQL as its native language. The program's built-in multiuser capabilities are also a plus. Otherwise, this latest version of R:BASE has nothing that makes it stand out among the database crowd.

R:BASE 5.0 for Windows. List price: \$495; upgrade, \$195. Requires: 6MB RAM (8MB recommended), 8MB hard disk space, Microsoft Windows 3.1 or later. Microrim Inc., Bellevue WA; 800-628-6990, 206-649-9500; fax, 206-649-2785.

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MAPPING

First St.: The Road to Demographics

By Bruce Brown

Geographic information system (GIS) mapping software can boost your company's marketing and sales efforts, help you plan for growth, and track customer service requests. Wessex Inc.'s \$1,995 First St. puts a tremendous amount of information at your disposal along with the tools to use it. The time you'll need to invest to learn and use First St. could pay big dividends.

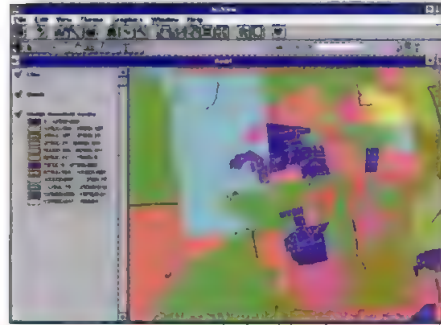
If spending almost \$2,000 on a program that produces maps and tables seems extravagant, you should realize that traditional GIS data providers, such as MapInfo Corp., sell their geographic and demographic data in pieces that can quickly add up to ten times the price of First St. The First St. package includes just about all you'll need to get started and seems a relative bargain in comparison.

Packaged on 17 CD-ROM disks, First St. comes with ArcView 2.0c for Windows, from GIS-giant Environmental Systems Research Inc. (ESRI), along with Wessex's own Pro/Filer application, which you use to select GIS and demographic data. Eleven CDs hold the U.S. Census Bureau's Tiger 92 files, the most up to date demographic data available for the country. This information is broken down in several ways: states, counties, cities, Congressional districts, townships, five-digit ZIP Codes, streets, census tracts, and Block Groups (which are the smallest units of information the Census Bureau releases, containing 200 or more addresses). The data is also organized based on Nielsen's Designated Market Areas (DMAs) and Arbitron's Areas of Dominant Influence (ADIs).

The remaining six CDs contain 3,000 demographic variables—ranging from income to ethnicity—from the 1990 U.S. Census. The information is broken down at the block group level.

You can use Wessex's included applications or build your own. ArcView also lets you use your

existing data on customers, suppliers, and competitors, or other information as long as it can be converted into dBASE, SQL, or delimited ASCII file formats. In addition, the data must be based



BLOCK BY BLOCK: First St. lets you examine Census data, such as median income.

on some geographic variable, such as address or ZIP Code.

There are a couple of problems with First St., the most onerous of which is that the program is resource hungry. You'll need at least a 486 PC with a math co-processor, a minimum of 16MB

RAM, a fast hard disk with lots of space (10MB is required for the program files and a minimum of 100MB of free space is recommended for data), a fast video adapter, and a CD-ROM drive. A multidisk CD changer would be a good investment, too, given the amount of disk swapping the program requires.

When you build your query using Pro/Filer's drill down type tables, the requested data is transferred from the CD to your hard disk. Once all the data is gathered, you use ArcView to organize it, pull it together, and create maps of interest.

Individual privacy is assured by the Census Bureau's restriction to Block Group data sets, so you can't find out about any one particular person. But if you're interested in such things as income, education, industry, schooling data, ethnic backgrounds, or other criteria, you can combine as many variables as you like, provided that

the information fits on your hard disk.

It takes quite some time to get up to speed using Pro/Filer and ArcView, primarily because of their loose adherence to Windows menuing conventions. ArcView's relational database capabilities are worth the effort as you learn how to create maps based on selected criteria. Minor irritants—including the program's habit of always asking you to specify your CD-ROM drive letter—are scheduled to be addressed in a forthcoming upgrade.

Not everyone in your company needs to learn and use First St., but after you turn a marketing manager loose with the program for a while, the geographic data you need to make your company grow can be right at your fingertips.

First St. List price: \$1,995. Requires: 16MB RAM, 10MB hard disk space (100MB additional space recommended for data), Microsoft Windows 3.1 or later, CD-ROM drive. Wessex Inc., Winnetka, IL; 800-892-6906, 708-501-3662; fax, 708-501-3691. Circle 401 on reader service card

DIAGRAMMING

SmartDraw Pro: No Muss, No Fuss Diagrams

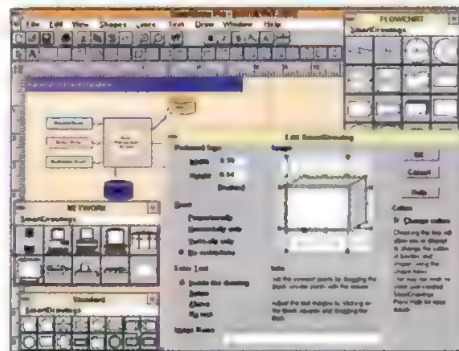
By J.W. Olsen

SmartDraw Pro 1.03 brings simple elegance and several new features to the diagramming and flowcharting market. In many ways, the program's drag-and-drop interface is reminiscent of Visio Corp.'s Visio and Micrografx's SnapGraphics, but SmartDraw Pro, at \$49, is much less expensive and is aimed at occasional diagrammers.

SmartDraw's strength lies in its ease of use: Non-artists can produce everything from a simple organizational diagram to a complex process flowchart. You add shapes and lines from a ribbon toolbar or any of the pro-

gram's 28 floating palettes. To use an object, you drag and drop it into place or click on it and then click on where you want it to go.

Connected objects stay con-



SHAPE SHIFTER: Open multiple floating shapes palettes, then double-click on their buttons to edit your illustration's properties.

nected even when the objects are moved, and three other features (Snap-to, Align, and Make Same Size) help maintain relationships

between objects in a complicated diagram. The program's in-place text editing capabilities, combined with objects that automatically resize themselves to fit the space, make creating or editing a SmartDraw diagram a delight.

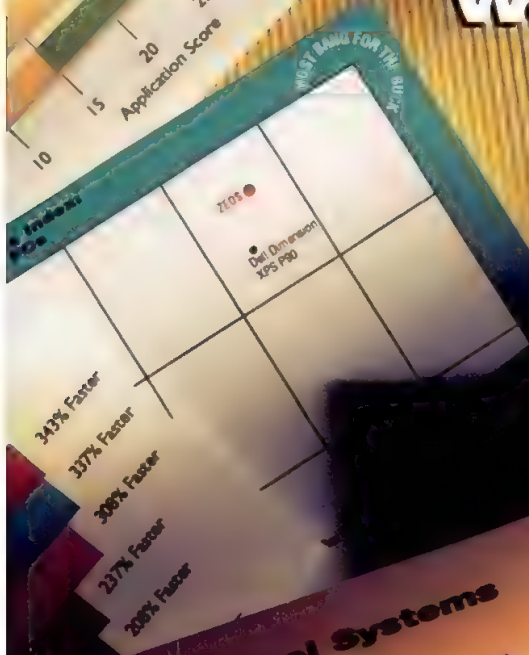
SmartDraw's relatively small number of line and shape objects is expected to be remedied in Version 2.0, slated for release later this year. At present, the number of included objects is adequate, but reflects SmartDraw's status as a first-release product.

SmartDraw Pro gets you up to speed fast—and at a fraction of the cost of its competitors.

SmartDraw Pro 1.03. List price: \$49. Requires: 4MB RAM, 7MB hard disk space, Microsoft Windows 3.1 or later. SmartDraw Software Inc., San Diego, CA; 800-501-0314, 619-549-0314; fax, 619-549-2830.

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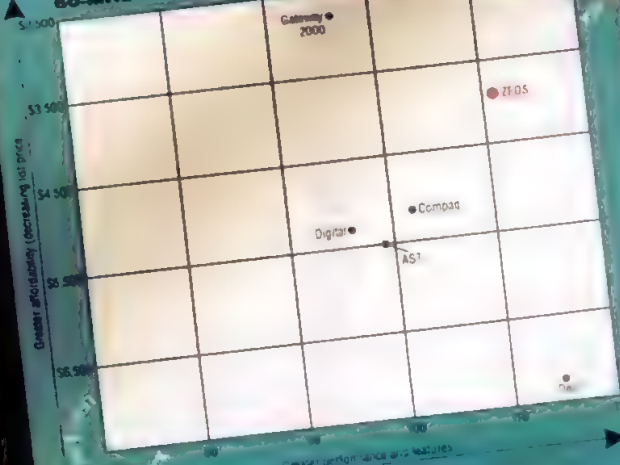


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ZEOS Pentium-90



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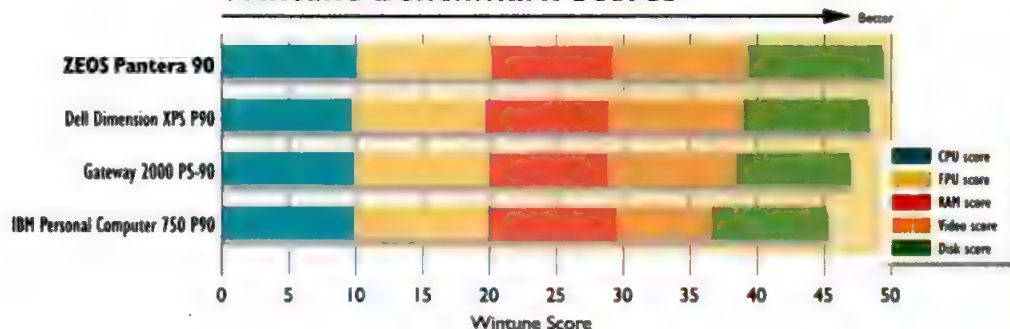
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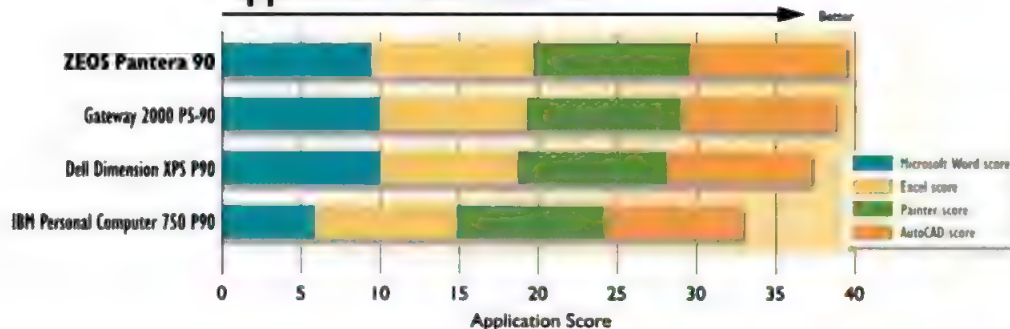
Once Again... "ZEOS® Clobbers The Competition."

- Windows Magazine, April 1995

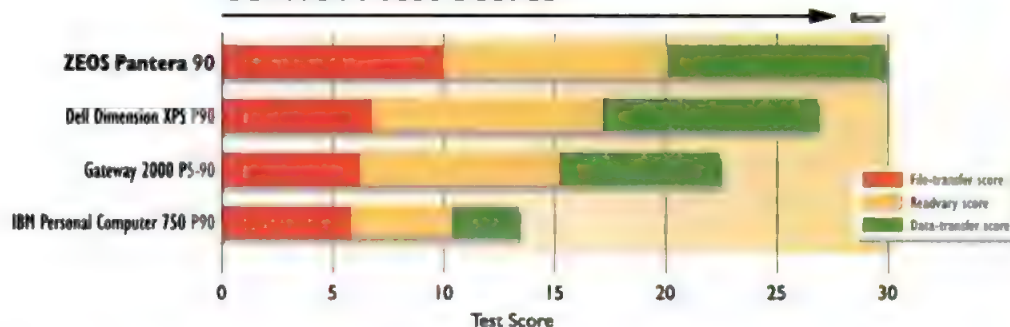
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Reprinted from Windows Magazine, April 1995

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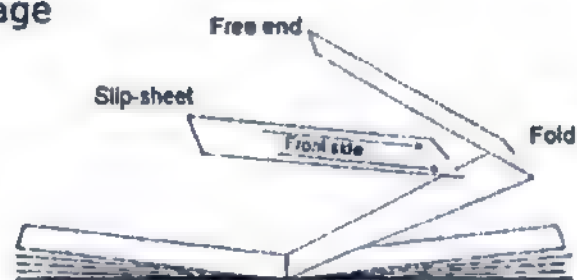
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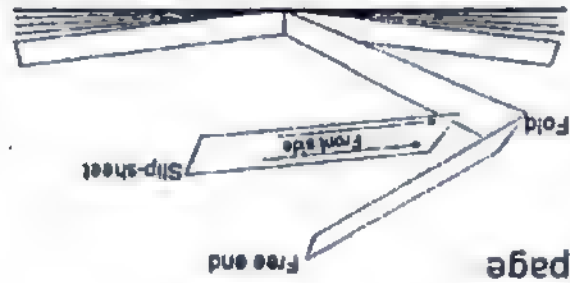
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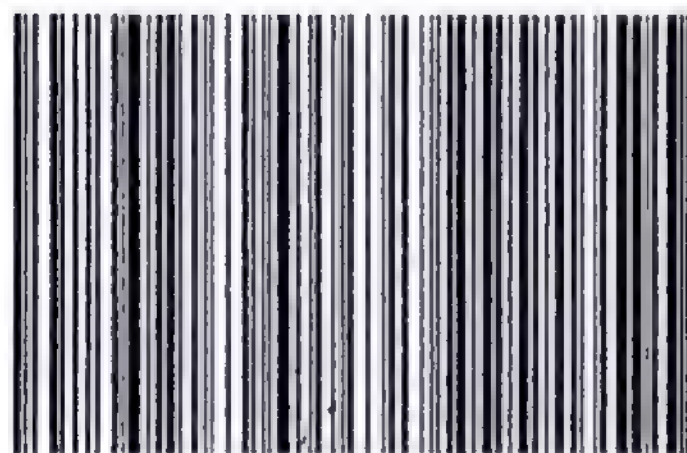


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Back

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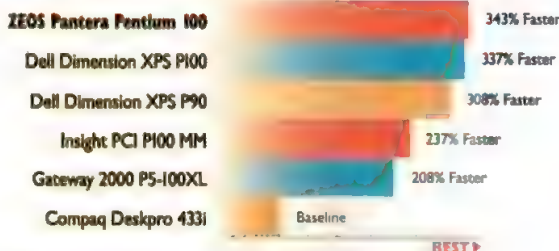
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Technology: Great sound. * * * *

Verdict: A definite winner. * * * *

Reprinted from *PC/Computing*, April 1995

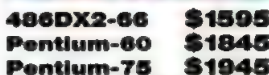
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KEYBOARDS

Key Tronic Combines Standard Keyboard with Windows-Specific Keys

By Edward Mendelson

Key Tronic designed its \$149 KB101 Plus-C keyboard for those who want the special Windows keys and cursor control that come with Microsoft's Natural Keyboard but prefer a standard layout to Microsoft's ergonomic split-keyboard design. If Microsoft's melted-surfbboard-like Natural keyboard seems too outlandish, Key Tronic's more mainstream approach may satisfy you.

The Key Tronic model looks like any IBM-style Enhanced keyboard, with the addition of three keys. Two of the three bear the Windows logo and fit between the Ctrl and Alt keys to the left and

right of the space bar. The third has an icon that looks like a Windows menu and sits between the right Ctrl and Alt keys, to the right of one of the Windows-logo keys.

OS-SENSITIVE

As with the Microsoft Natural Keyboard, these new keys act differently under different operating systems. Under DOS, they do nothing. Under Windows 3.x, the two logo keys pop up the task list, while the menu key does nothing.

Under Windows NT, the keys act as they do under Windows 3.x—with one exception: When the two logo keys are pressed together, they bring up Windows



KEY TO COMPUTING: With Windows-specific keys (see inset), the Key Tronic keyboard can customize itself to several operating systems.

NT's log-on/log-off menu. Finally, when the keyboard is used under Windows 95, the logo keys bring up the Start menu while the menu key brings up the property sheet of the current screen—just like the right mouse key.

Microsoft's IntelliType keyboard-control software is included with both the Key Tronic and Microsoft keyboards. Under Windows, the software gives you the

option to use the numeric keypad to control the cursor and adds a "sonar" option that displays circles around a lost mouse pointer when you press the Ctrl key.

IntelliType also adds some of the same mouse-control options that come with the latest Microsoft Mouse software. The most useful are the options that make the pointer snap to the default button in a dialog box and "wrap around" from one edge of the screen to the opposite edge.

The software only offers these advanced options if you identify your keyboard in the setup dialog box as having the special Windows-logo keys. But we found that these options worked with any standard keyboard as long as you tell the software that the keyboard has the logo keys.

Wireless Keyboard & Mouse: Untethered Input

Wireless Computing's \$499 RF-50 Wireless Keyboard & Mouse Touchpad untethers your input devices from your computer. This system can free your desktop from a tangle of cables or let you control a PC-based presentation while you're up to 30 feet from your computer.

The system consists of three parts: a keyboard, a touchpad (which replaces your mouse), and a receiving station. Set up is quick and simple. You plug the receiving station, complete with anten-

nna, into your PC's keyboard and mouse ports or its serial port. You then insert a 9-volt battery into the touchpad unit and plug the keyboard into a port on the touchpad. The touchpad transmits keystrokes and mouse movements to the receiving unit via radio frequency broadcasts.

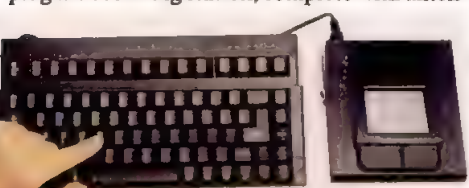
We found the touchpad responsive and very easy to get used to, especially with its generously large activation buttons. The unit's thickness and recessed active area can, however, make it uncomfortable to use for long periods.

Wireless Computing claims that the keyboard and touchpad will operate up to 30 feet away from the receiving station. In our testing, this claim held up only if we kept the receiving station clear of the monitor. We found that results were diminished if the line of sight from the touchpad to the receiving station came within a few inches of the monitor.

The major problem with the design is that the keyboard and the touchpad are separate units connected by a cable. The result is that you have to carry two units to the lectern instead of a single integrated device. We would have preferred a single unit that combined keyboard and touchpad, but the inconvenience of a cable that connects the two units is a small price to pay for the convenience of having a keyboard and touchpad anywhere in the room.—EM

RF-50 Wireless Keyboard & Mouse Touchpad. List price: \$499. Wireless Computing Inc., Dallas, TX; 214-719-2515; fax 214-719-2578.

Circle 423 on reader service card



TOUCH AND RUN: The RF-50 wireless system allows you to roam up to 30 feet from a PC.

na, into your PC's keyboard and mouse ports or its serial port. You then insert a 9-volt battery into the touchpad unit and plug the keyboard into a port on the touchpad. The touchpad transmits keystrokes and mouse movements to the receiving unit via radio frequency broadcasts.

The keyboard is a small-footprint 83-key model that measures 1 by 13.75 by 6.25 inches (HWD) and is similar in size to those used on many notebooks. The touch is springy, with pos-

ADJUSTABLE FEEL

Another reason you may want to keep the software even if you retire the keyboard is that Key Tronic's keyboards lack the snappy response you get from high-end keyboard vendors like Hewlett-Packard, Lexmark, and Northgate. You can change the feel of the keyboard by ordering one of three \$15 Custom Key Feel Kits and replacing the rubber domes under each key with softer or harder versions (expect to spend about a half hour retrofitting your keyboard). But you won't get the characteristic solidity of high-end designs.

If you like having your name on your keyboard, Key Tronic will send you a personalized nameplate for \$5.

Key Tronic KB101 Plus-C. List price: \$149. Key Tronic Corp., Spokane, WA; 800-262-6006, 509-928-8000; fax 509-927-5224.

Circle 422 on reader service card

COLOR MULTIFUNCTION PRINTERS

Lexmark Medley Adds Color to Your Office

By Alfred Poor

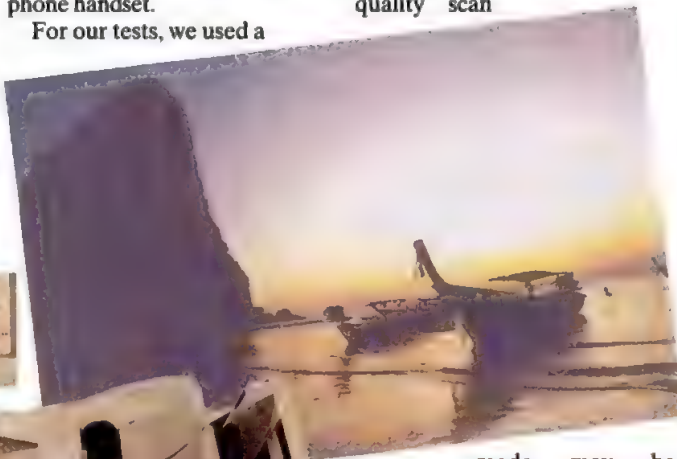
The \$900 Lexmark Medley 4x multifunction peripheral breaks through the color barrier. This one-of-a-kind office device can not only do the expected chores of printing, copying, sending and receiving faxes, and scanning images, but it can also print in color. In spite of some design mistakes, the Medley 4x defines a new class of multifunction printers.

Inside the Medley 4x, you'll find the same ink jet print engine used by the Lexmark Exec IIc printer. Rated at 300-dot-per-inch resolution for color printing and 600- by 300-dpi for monochrome, the Medley 4x uses Lex-

a photo setting that can recognize up to 64 shades of gray. Unlike most of the competition, the Medley 4x doesn't come with a telephone handset.

For our tests, we used a

image in the photo setting (in dithered gray-scale) took more than 16 minutes. The extra time that is required by this higher quality scan



COLOR ON DEMAND:

Lexmark's Medley 4x is the first office hydra to offer color printing, although its tiny control panel is hard to read and use. The Medley 4x produced pronounced banding in black regions.

mark's POET edge-smoothing technology. The printer is rated at up to 3 pages per minute for monochrome pages.

SCAN AND SEND

For scanned input, the Medley 4x is rated at 300 dpi (most of the competition offers only 200-dpi resolution), and the unit can create gray-scale images (the competition generally works with dithered 1-bit images). The system sends scanned data to your PC's bidirectional parallel port, so there is only one cable that connects the Medley peripheral to your computer.

The send/receive fax modem can operate at up to 14.4 kilobits per second, and there are three separate fax quality modes (normal, fine, and superfine) as well as

Medley 4x model, which includes only a monochrome ink cartridge, plus an optional \$37.95 three-color ink cartridge. The Medley 4x managed to produce 2.4 pages per minute in the PC Labs Text Speed test. It took from 2 to 7 minutes to produce a color print.

Print quality was generally good, with the resolution-enhanced text approaching that of a laser printer. There was some noticeable banding on graphics with large black regions, but it was comparable with other ink jet printers. In addition, when using the three-color cartridge, black regions were rendered a muddy brown color.

The Medley 4x offers a multitude of scanning choices. The unit took 25 seconds to produce a 1-bit black-and-white scan and 55 seconds for a 1-bit scan that dithered the gray-scale portions of the test-page image. To scan the same

mode may be enough to discourage many people from using it except on rare occasions.

Making a convenience copy takes just under 4 minutes. The Medley 4x can scan a page into its own memory while making copies, and you can feed up to 20 originals at a time into the Medley 4x's document feeder. The system can also automatically collate multiple copies of multi-page originals. You can make up to 99 copies of a single page in one operation.

The unit comes with Dank Industries' FAXsynergy software, which handles fax and scanning tasks well. You can create multiple phone books, fax stored documents, and more. The Medley 4x also includes a Twain-compliant driver so you can scan images directly into many Windows applications.

The product's major drawback is that it uses a separate three-color ink cartridge for color printing. If you want to make a copy or print an incoming fax, you have to remove the color cartridge and install the black one. While this is inconve-

nient and time consuming, the unit does include a handy place to store the extra ink cartridge when it's not in use.

Despite Lexmark's reputation for solid design and construction, there are some features that could have been handled better. A flimsy hatch covers a 14-button control panel, and the tiny buttons and labels will tax the eyesight of many users. The front panel configuration controls are at times cryptic, and users who turn to the manuals will be frustrated by an inadequate index, commands that aren't explained, and configuration sequences that don't match the choices that appear on the front panel message screen (the manuals have since been rewritten and are available at no cost to early purchasers).

EXPANDING HYDRA

At 15 by 15.4 by 12 inches (HWD), the unit's housing is fairly compact, but the space requirements more than double when you hang the wire paper tray on the scanner output slot. The paper input tray holds up to 150 sheets of paper, which is 50 percent more than most products in this class. This increased capacity is offset by the fact that we had repeated problems with pages in the manual feed slot not being picked up properly.

The Medley 4x, up against its major competitors, comes out well: It offers higher resolution scans and faster fax throughput than either the HP OfficeJet or the Canon B160. At \$900, the Lexmark Medley 4x is on a par with these monochrome ink jet office hydras. It's as if Lexmark is throwing in the Medley 4x's color printing and gray-scale scanning abilities for free.

Medley 4x. Estimated street price: \$900; replacement black ink cartridge, \$31.95; color ink cartridge (not included), \$37.95. Lexmark International Inc., Greenwich, CT; 800-358-5835, 606-232-2000. Circle 427 on reader service card

FIRST LOOKS PLUS

From July 3 through 7, you can go on-line to discuss Lexmark's Medley color multifunction device with product manager Denis Guiliani and reviewer Alfred Poor. Type GO EXEC at any CompuServe 1 prompt.

COLOR SCANNERS

Avec Colour 2400 Delivers the Full Spectrum for \$499

By Rick Broida

T rue or false: With a flatbed scanner on your mind but only \$500 in your pocket, you can forget about anything that reproduces color. True—at least until the advent of the Relisys Avec Colour 2400, which delivers high-quality 600- by 300-dot-per-inch 24-bit color scans and has an estimated street price of \$499.

The Avec 2400 produced sharp, clean scans with a variety of samples. Most of the output was on a par with the more expensive Agfa Studio Scan and HP ScanJet IICx scanners, although some 300-dpi Avec scans had colors that weren't as vibrant as we would have liked.

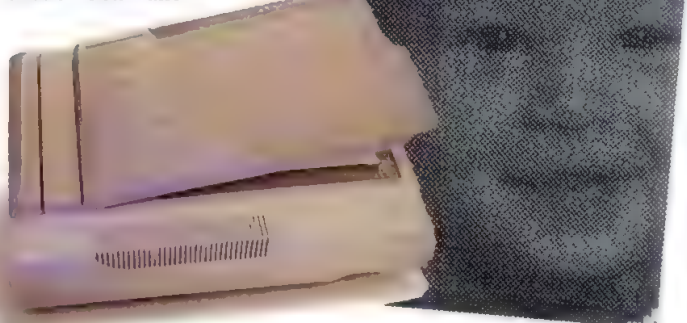
We were also impressed with the Avec 2400's monochrome abilities. The scanner produced excellent 256-level gray-scale and line-art images. Software interpolation can boost the resolution to 2,400 dpi.

The Avec 2400 employs Cold-Scan technology, which extends the scanner's lamp life and prevents dust from building up on the 8.5- by 14-inch scan bed. With its jointed lid, the Avec 2400 can easily accommodate large books. For an extra \$399, you can get a 50-page automatic document feeder.

Installation of the Avec scanner was a snap, thanks largely to the jumperless DTC 3153 SCSI-2 host adapter card. But because this 8-bit card recognizes only one port address, you'll have to reconfigure other devices if a conflict arises. We experienced no setup problems but felt hampered by the 3-foot SCSI cable.

With the scanner's low price come some compromises, though none are major. First, the scanner makes three passes to capture color, which increases scan times compared with costlier single-pass models. Second, the only software included is ArtScan, a functional but crudely designed Twain driver. ArtScan provides acceptable control over settings like resolution, sharpening, and image scale, but it lacks artistic controls, does not contain on-line

help, and can be awkward to use. For example, to alter color or saturation, we first had to deselect the spectrum levels check box and



COLOR ON THE CHEAP: The Avec 2400 scanner produces 600- by 300-dpi color for less than \$400. The unit's image quality was impressive, although colors were sometimes washed out.

WIRELESS PRINTING

JetEye Cuts The Printer Cord

By Gregg Keizer

E xtended Systems' JetEye ESI-9580A infrared transceiver retrofits any printer for wireless printing. The \$179 gadget is an easy way to cut your notebook free from printer cables.

The combination of a printer and the JetEye device matches the abilities of newer printers that have built-in infrared (IR) capabilities, such as Hewlett-Packard's HP LaserJet 5P/5MP series (First Looks, June 13, 1995). The JetEye is compliant with the IrDA standard (supported by HP, IBM, and other notebook makers) and sets up in seconds; you just plug the device's parallel-port adapter into the printer. The adapter includes a pass-through parallel port.

A 6-foot-long cable lets you position the crescent-moon-shaped JetEye receiver module in a convenient location. Just point the notebook's IR window at the JetEye device and print. An external power supply is included, but the JetEye is self-powered if you set it within about a foot of the notebook.

To transmit a file via IR, your notebook must have an IrDA-compliant port and a special IR driver. Extended Systems includes an IR-ready driver with the JetEye.

We tested the JetEye on an HP LaserJet 4MP printer using an HP OmniBook 600c notebook configured to print via its integrated IR transceiver. Print chores generally flashed between the note-



BEAM ME UP: Extended's JetEye IR printing system prints without any wires.

book and the JetEye without a hitch.

While the JetEye's range is a claimed 3 feet, we were able to reliably transmit from as far as 4 feet. The range between the same notebook and an HP LaserJet 5MP printer with a built-in IR window was about 6 feet.

then reselect it to bring up the appropriate dialog box. The added cost of \$50 for Adobe Photoshop LE and Caere OmniPage Direct is money well spent.

You'll still be stuck with ArtScan for acquiring images, though. Sometime this summer, Relisys will introduce an upgraded ArtScan Professional, which will be available as a \$24.95 upgrade.

Despite a few missteps, the Avec Colour 2400 ends the long wait for affordable desktop color scanning.

Avec Colour 2400. Estimated street price: \$499. Requires: 8MB RAM, 2MB hard disk space, available 8-bit expansion slot, Microsoft Windows 3.1 or later. Relisys, Image Processing Division, Milpitas, CA; 800-945-0900, 408-945-3113; fax, 408-945-1499. Circle 426 on reader service card

Wireless print speed was about equal to that of a direct parallel connection between a PC and a printer. And after we interrupted the transmission for about 45 seconds by placing a book between the JetEye and the notebook, printing gracefully resumed. Longer interruptions require the print job to be repeated. To get the best results, the notebook requires a stable platform. When it

was held or placed on a lap, the wireless link wouldn't work.

Extended Systems also offers the JetEye PC ESI-9680A, a \$135 device that attaches to a PC's serial port for wireless file transfers. The JetEye PC lacks file-transfer software, however, and third-party IrDA-compatible software is in its infancy.

Going wireless with the JetEye is an expensive convenience compared with the price of a parallel cable, but it's an easy way to beat the bother of cables when using a notebook.

JetEye ESI-9580A. List price: \$179. Requires: IrDA-compliant portable computer, Microsoft Windows 3.1 or later, printer. Extended Systems Inc., Boise, ID; 800-235-7576, 208-322-7800; fax, 208-377-1906.

Circle 428 on reader service card

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OCR SOFTWARE

WordScan Plus 4.0: Accuracy's The Name of the OCR Game

By David Haskin

Caere Corp. doesn't claim that its \$595 WordScan Plus 4.0 is the Holy Grail of optical character recognition (OCR) software, but its newly rebuilt recognition engine is impressively accurate. Caere says that's because the 32-bit neural net-based engine analyzes entire words, not just individual characters. As a \$149 upgrade, WordScan Plus 4.0 extends OCR capabilities.

We tested WordScan 4.0 and compared it with the previous version using two scanners: an HP ScanJet 3c with AccuPage technology and a Plustek Scan FX. Our results showed that this upgrade is superior to Version 3.0; we also found that the new version could perform some particularly notable feats when coupled with AccuPage technology.

COMPLICATED RECOGNITION

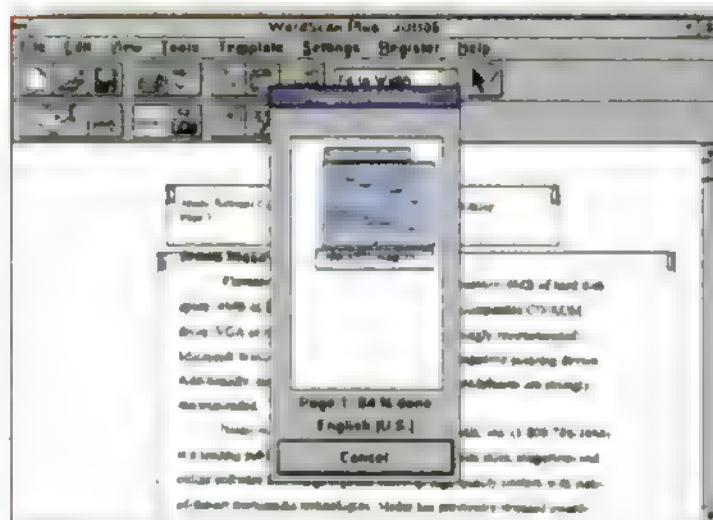
One test document we used, for example, had multiple staggered columns, a variety of fonts, and type sizes as small as six points. Attempting recognition of this document with WordScan 3.0 and the Scan FX scanner produced unusable gibberish. The WordScan 4.0 and Scan FX combination produced much better results: 28 recognition errors out of 574 words with seven-point type or higher. Still, there was no successful recognition of words in six-point type. When we used WordScan 4.0 and the ScanJet scanner with AccuPage, however, the results were greatly improved: only 14 errors—and all the six-point words were correctly recognized.

WordScan 4.0 is better than Version 3.0 at recognizing tables with numbers in small type sizes, and the program's ability to maintain layout integrity has also been improved. While WordScan 3.0 placed sections of a multicolumn magazine article in the incorrect sequence, WordScan 4.0 did a better job of getting the article's sequence in the correct order. Another improvement:

WordScan used to save graphics like magazine illustrations as separate files. It now can create compound documents of text and graphics.

RECOGNIZE BY ZONE

Version 3.0 lets you launch scanning sessions from nearly any Windows application without DDE links. Now, with Version 4.0, you can also manually create recognition zones from other applications. Zones are boundaries you draw around sections of a scanned document; WordScan recognizes zones



IMPROVED ACCURACY: WordScan's rebuilt OCR engine improves recognition accuracy.

in the order you specify.

Microsoft Word for Windows users will appreciate the fact that you can click on a toolbar button in WordScan to begin the scanning process. When completed, WordScan automatically loads Word for Windows and inserts the recog-

nized results. This trick doesn't work with other word processors, however.

WordScan Plus 4.0 doesn't attain the elusive goal of perfect character recognition, but this upgrade provides both impressive accuracy and improved connectivity to your other applications. **WordScan Plus 4.0.**

List price: \$595; cross-platform upgrade, \$149. Requires: 4MB RAM, 13MB hard disk space, Microsoft Windows 3.1 or later. Caere Corp., Los Gatos, CA; 800-535-7226, 408-395-7000; fax, 408-354-2743.

Circle 417 on reader service card

PageKeeper: A Virtual File Cabinet

Gathering information can sometimes be difficult, and finding precisely the information you need can sometimes seem impossible. Caere's PageKeeper 2.0 is a unique document management product that approaches the problem from both sides: It helps you collect information from virtually any electronic source, and then it quickly finds what's important to you.

One PageKeeper strength is the wide variety of information it handles. You can scan documents into PageKeeper and either save them as images or apply optical character recognition (OCR). PageKeeper uses OmniPage's recognition capabilities—not the newly updated WordScan Plus 4.0 recognition engine. Faxes can be incorporated into PageKeeper as well.

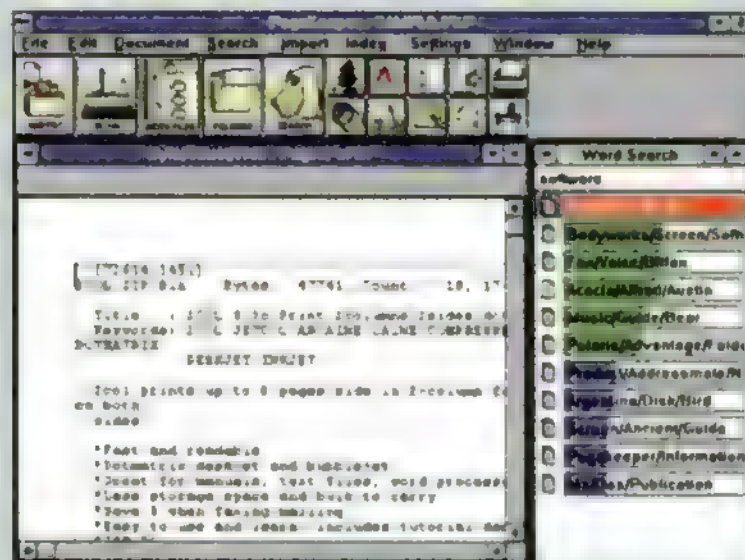
PageKeeper can also import documents from other applications or track them in their native formats. Among the applications that PageKeeper works with are Ami Pro, Lotus 1-2-3, Microsoft Excel, Microsoft Word for Windows, and WordPerfect. PageKeeper can also be your on-line file cabinet, tracking information from America Online, CompuServe, and Prodigy, as well as e-mail from any MAPI- or VIM-based mail system. You can annotate PageKeeper files with a yellow sticky note that can be placed anywhere in the document.

PageKeeper is noteworthy for its intelligent text-retrieval capabilities. It analyzes found documents and highlights files it deems most relevant in red and those of less perceived importance in blue or green. PageKeeper uses several criteria for determining relevance, including the frequency with which search terms appear in a document.

We found this ability to rank documents—which Caere claims is improved in this version—to be useful as long as you don't expect too much

from it. While it does often speed the process of finding specific information, we found the ranking process to be imprecise and off-base at times.

And while PageKeeper is powerful and unique, some basics still need more work. The program indexes text to speed retrieval, but indexing 100K of Word for Windows files took a glacial 2 minutes on a 90-MHz Pentium system with 16MB of RAM. PageKeeper also has limit-



COLOR MY WORLD: PageKeeper color-codes file names to denote importance.

ed Boolean search capabilities: It supports only the AND and OR search modifiers; missing is the commonly used NOT modifier.

Still, if information is bombarding you from all directions, PageKeeper is one way to keep it close at hand.—DH

PageKeeper 2.0. List price: \$195; upgrade, \$49. Requires: 8MB RAM, 8MB hard disk space, Microsoft Windows 3.1 or later. Caere Corp., Los Gatos, CA; 800-535-7226, 408-395-7000; fax: 408-354-2743.

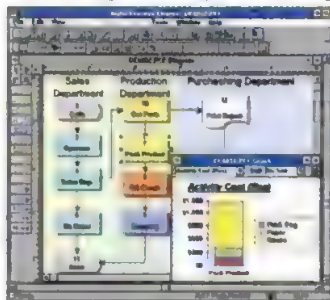
Circle 418 on reader service card

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PRESENTATION GRAPHICS

Montage Creates Order out of Presentation Chaos

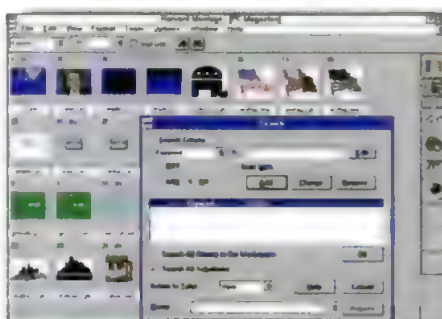
By Eryn Brown

Software Publishing Corp.'s \$100 Harvard Montage adds a twist to the old multimedia-organizer concept by allowing you to organize Harvard Graphics, Freelance Graphics, and PowerPoint presentations along with the images, sound files, and video files that go with them.

Montage is organized around an album metaphor. You start by importing your existing presentations and other files through the Insert Thumbnail dialog box.

Montage collects keywords from the presentations, and you can enter additional information to assist searching.

You can view just the filenames or thumbnails of the presentation slides. The slides can be organized into albums by dragging and dropping the thumbnails or by using the program's



SEARCHING PARTY: Harvard Montage's keyword search operations help you organize and reuse presentations.

user-defined sort routines. Once assembled, Montage albums can be searched by keyword, file type, file size, description, and other criteria. It's not necessary to have the presentation graphics applications installed to use Montage, but you'll need them if you want to do any editing.

Harvard Montage's strength is its ability to organize files from many applications in one place. **Harvard Montage.** Estimated street price: \$100. Requires: 4MB RAM (8MB recommended), 11MB hard disk space, Windows 3.1. Software Publishing Corp., Santa Clara, CA; 800-234-2500, 408-986-8000; fax, 410-224-2876. Circle 419 on reader service card

WORD PROCESSING

Dagesh2: The PC's Right-to-Left Word Processor

By Barry Simon

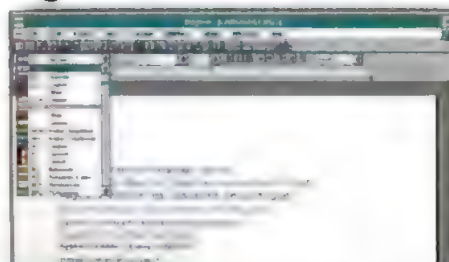
If your business dealings take you to the Middle East or the former Soviet republics, Kivun Software's Dagesh2 may be your answer to what could otherwise be a word processing nightmare. Distributed domestically by Davka Corp., the \$199 Windows-based, Hebrew/English word processor is a refreshingly flexible—if not full-featured—multilingual program.

Though Dagesh2 focuses on Hebrew, there are more than 100 TrueType fonts for 24 Hebrew-language families, 3 Arabic-language families, 3 Russian-language families, and 3 Greek-language families. Just pick the dialect and Dagesh2 will load the default fonts and spelling dictionary you'll need.

Dagesh2 has many of the traditional formatting features and basic style sheets found in today's most popular word processors. This version also includes tables, headers and footers, and the ability to embed common graphics-file formats.

Though you can perform mail-merge functions, the data file must be a Dagesh2 document. Other drawbacks include Dagesh2's lack of OLE support, toolbar customization, a thesaurus, an envelope printer, and a macro language.

Dagesh2 generally looked fine



CHOOSE YOUR LANGUAGE: With its drop-down menu, Dagesh2 makes it easy to select the language for new or highlighted text.

on a VGA monitor, but we noticed some display glitches with some Super VGA screen drivers. And since the .FOT font files supplied with the program are not standard U.S. Windows .FOT files, the fonts can only be installed through Dagesh2 and cannot

be organized with programs such as Font Minder.

For now, Microsoft Word's Hebrew/English version requires Hebrew Windows, as will the upcoming Hebrew release of WordPerfect for Windows. Dagesh2 is your best bet for producing mixed Hebrew/English documents.

Dagesh2. List price: \$199. Requires: 4MB RAM, 15MB hard disk space, Microsoft Windows 3.1 or later. Davka Corp., Chicago, IL; 800-621-8227, 312-465-4070; fax, 312-262-9298.

Circle 420 on reader service card

SOFTWARE

400/Manager Brings Mainframe Data into Windows

By Mark Jonikas

IBM AS/400 users can rejoice in the arrival of 400/Manager, Version 2.1.3. The \$395 package from ITS includes a long-awaited Windows-based file-administration, query, and reporting tool that lets you search and browse AS/400 files and move them into Windows apps.

The software has a clear and intuitive interface. You select a working library and follow the prompts to log on to your company's AS/400 mainframe. The program's search function allows specific fields to be selected, sorted, and displayed; you can refine your search by entering search criteria. Click on the retrieve button, and 400/Manager generates a report window containing the

file's contents. The data can then be printed or exported in comma-delimited ASCII format.

We installed 400/Manager on an AS/400 Model 30S running Version 3 R1 of the platform's operating system, and our tests on simple files ran without a hitch.

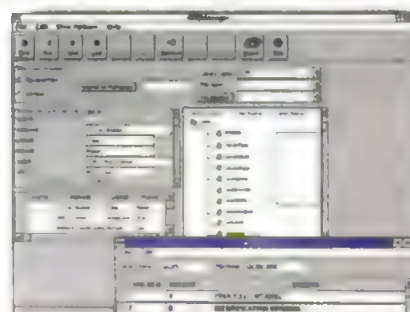
We didn't run into a problem until we tried to access a file containing a packed decimal field. When this field was omitted from the field select list, we were able to download the file; ITS is working on a solution.

While there's room for improvement, 400/Manager finally gives AS/400 users the opportunity to share their data with

Windows applications.

400/Manager, Version 2.1.3. List price: \$395. Requires: 8MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later, AS/400. ITS Inc., New Orleans, LA; 504-539-9300; fax, 504-539-9304.

Circle 421 on reader service card



FIND: 400/Manager allows you to move AS/400 data to a Windows application.

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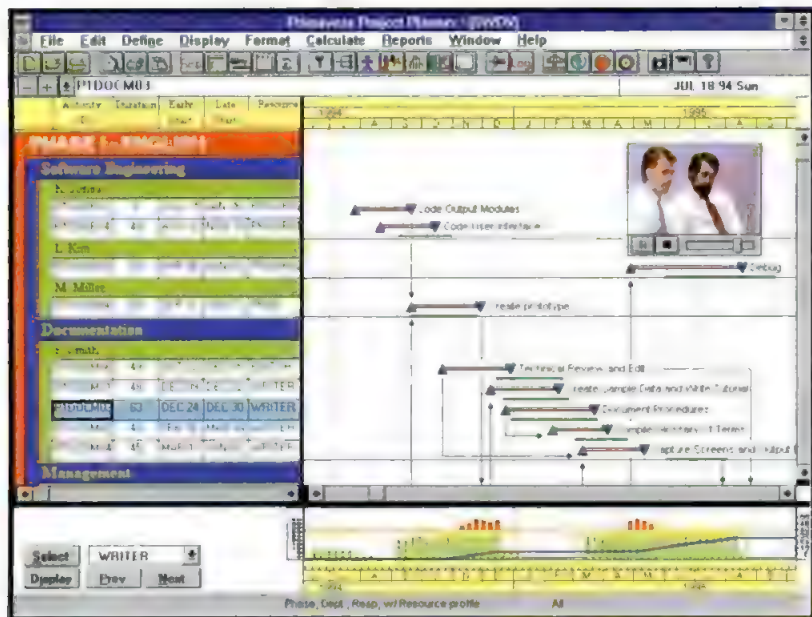
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Asa Somers

CD-ROM Mag: Launch Blasts into Outer Orbit

To set a CD-ROM-based entertainment magazine apart from the growing crowd, you'd better have one thing: good content. Launch, a new \$8.99 bimonthly from **2Way Media**, provides a particularly hip collection of music, movie, and entertainment information that outdoes its current competition.

Launch City, the CD-ROM's good-looking home screen, provides one-click access to the Hang, where you can watch interviews with musicians and sample the latest cuts from up-and-coming bands; the Cinema, which houses full-



AD IT UP: Even the billboards in Launch City can lead to fun, interactive multimedia.

length movie trailers, video features, and articles from *Premiere*, as well as computer game demos, interactive music videos, animated shorts, and—of course—interactive product advertisements. The first issue features Matthew Sweet, NYC pop group Ivy, and the trailer for *Batman 3*.

Launch. List price: Single issue, \$8.99; six-issue yearly subscription, \$35.99. **2Way Media Inc.**, Santa Monica, CA; 800-955-2862.

Circle 407 on reader service card

UnInstaller 3 Cleans Up

UnInstaller 3, the latest version from **MicroHelp**, features new application-management features and Windows clean-up utilities. A new Move command lets you transport applications and their related files to another drive or directory, and Archive will compress and store infrequently used apps.

UnInstaller 3. List price: \$79.95 (plus \$10 rebate from company); upgrade, \$29.95. **MicroHelp Inc.**, Marietta, GA; 800-777-3322; fax, 404-516-1099.

Circle 408 on reader service card



Six-Speed CD-ROMs Make IDE Connections

Boasting substantially higher throughput and quicker access times than their quad-speed brethren, six-speed CD-ROM drives are the latest innovation to hit the multimedia market. Now, **TEAC America** and **Weames Peripherals International Corp.** (WPI) have announced models with IDE interfaces, promising wide compatibility and straightforward setup.

The \$549 **TEAC 6X CD-ROM** drive (above, left) is a standard 5.25-inch half-height internal unit that claims a blazing one-third-stroke seek time of 110 milliseconds (ms). The TEAC features a maximum data-transfer rate of 900 kilobytes per second (most 4X drives muster around 600 KBps) and comes with a 256K data buffer.

Initially, WPI intends to sell its 6X WPI **CDD-320** (above, right) primarily in OEM channels, although end users can purchase units directly from the company. Like the TEAC, the WPI model supports a maximum data-transfer rate of 900 KBps, but the company claims an average seek time of 190 ms. This model retails at an attractive \$399. It also incorporates a two-button front-panel design, allowing users to operate the drive as a standard audio CD player without software interference.

Both the TEAC and WPI drives support a number of CD-ROM formats, including CD-ROM XA and Kodak Multi-Session Photo CD. They should be shipping by the time you read this.

TEAC 6X CD-ROM. List price: \$549. **TEAC America Inc.**, Montebello, CA; 213-726-0303; fax, 213-727-7652.

Circle 405 on reader service card

WPI CDD-320. List price: \$399. **Weames Peripherals International Corp.**, San Jose, CA; 408-432-1888; fax, 408-432-1884.

Circle 406 on reader service card

Tales from the Encryption

It's the Kevin Mitnicks you have to watch out for when sending sensitive information over the Internet. Utilizing the one-time-pad encryption method, the POTP (Power One time Pad) Secure FTP and POTP SecurE-mail packages from **Elementrix** give you a fast, easy, and effective way to keep insistently nosy hackers at bay.

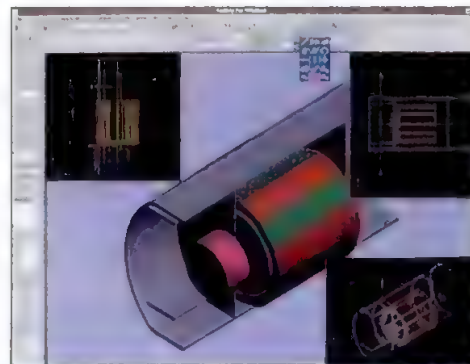
One-time-pad encryption assigns randomly generated decryption keys to each encoded message, thereby making intrusion exponentially more difficult. Both the sender and receiver must be using the same encryption package, however. These two POTP packages automatically alert you to attempted intrusions and communications failures such as line disconnections or computer crashes. The coding and decoding of data is very quick, and the application remains virtually transparent to the user. Elementrix plans to offer both the FTP and e-mail packages in a single POTP Internet Security Pack later this summer.

POTP Secure FTP. List price: \$495. **FTP SecurE-mail.** List price: \$245. **Elementrix Inc.**, New York, NY; 800-354-7011, 416-221-3363; fax, 416-223-4041; e-mail, info@potp.com.

Circle 409 on reader service card

CADKey: Unlocking CAD For Under 800 Dollars

Now in its first Windows-based incarnation, **Cadkey's** eponymously named CAD package brings full-featured drawing and design capabilities to users for \$795. **CADKey** for Windows' new user interface features a customizable pop-up toolbar and context-sensitive help. The package's Picture It shape-recognition software handles the smooth-shading of renderings as you convert



OPPOSING VIEWS: CADKey lets you see objects from multiple angles simultaneously.

New & Improved

wireframes to 3-D objects; your objects will change according to alterations you make to the associated wireframes. You can view designs from multiple angles simultaneously, do mass properties analysis, and output for stereolithography prototyping applications.

CADKey for Windows. List price: \$795. Cadkey Inc., Windsor, CT; 800-394-2231, 203-298-8888.

Circle 410 on reader service card

You've Got a Friend

Office suites are cropping up everywhere, and each one offers a different assortment of applications and utilities. Along these lines, **Corel Corp.** has introduced the Corel CD Office Companion, which is not so much a suite in the traditional sense but an interesting combination of a business graphics package, an Internet browser, flowcharting software, a fax package, a PIM, and tons of clip art.

The \$149 Companion includes the powerful



DROP IN THE BUCKET: A 15,000-image clip-art library is but a part of the Office Companion.

CorelFLOW 2.0, featuring loads of symbols and many high-end flowcharting features; Corel-Gallery 2, a multimedia file manager and huge clip art library; the CorelPlanner PIM; Corel-Bookcase, comprising an electronic encyclopedia, dictionary, almanac, and other reference materials; CorelFax, a complete fax package; and the Corel Web Mosaic browser. The Companion also includes audio-CD, screen-saver, sound-editing, and systems-diagnostic utilities.

Corel CD Office Companion. List price: \$149. Corel Corp., Ottawa, Ontario, Canada; 800-772-6735, 613-728-3733; fax, 613-761-9176.

Circle 412 on reader service card

GLoria: A GLint of the Future of 3-D Graphics

The future of graphics is 3-D, and the **ELSA GLoria**, a PCI-based, single-slot graphics accelerator that pairs the GLint 300SX chip from 3D Labs with S3's Vision968, a 64-bit 2-D graphics controller, fills the bill. The card supports up to a 1,600-by-1,280 resolution in 24-bit color.

HARDWARE BRIEFS

The new \$1,179 HP ScanJet 3c from **Hewlett-Packard Co.** does 600-dpi, 30-bit color scans from reflective sources such as paper. The 3c handles 1,024 levels of gray and comes with Corel Photo-Paint 5 and Calera's WordScan character-recognition software. An optional \$759 adapter lets you scan from transparent media such as slides. 800-722-6538, ext. 9425, 208-396-2551.

Aimed at super power users, the \$16,497 AXP275 Ultra from **BTG** uses Digital's 275-MHz 21064A Alpha RISC chip to provide top-of-the-line performance. The Ultra comes with a 2GB hard disk, 64MB of RAM (upgradable to 1GB), 7.5MB of VRAM, a 6X CD-ROM drive, a 21-inch Nokia display, and a 100BaseTX Ethernet interface. 703-641-1200.

Starting at \$6,999, the Multibook from **Boxlight Corp.** features an active-matrix TFT screen that can be detached for use as a presentation panel with an overhead projector. The Multibook has a 486DX4/75 or better CPU, a 520MB removable hard disk, and 16K of RAM. It weighs 6 pounds and runs for up to 4 hours on a single battery charge. 800-762-5757, 360-779-4479.

GCC Technologies has introduced two new large-format, edge-to-edge laser printers: the \$1,999 entry-level Elite XL 408 and the \$3,999 high-end Elite XL 1208. The 408 can do 600-by-600 printing on letter-size sheets and 400-by-400 printing on tabloid pages, while the 1208 can handle 1,200-by-1,200 resolution regardless of paper size. 800-422-7777.

For the corporate user demanding a value color monitor, **Compaq Computer Corp.** has introduced the Compaq 140 14-inch and 150 15-inch models, starting as low as \$318. Both the 140 and 150 integrate Compaq's AssetControl desktop-management utility, and both support 1,024-by-768 resolution and have 0.28-mm dot pitch. 800-888-5858.

Featuring four personal voice mailboxes, remote fax and voice message retrieval, fax forwarding and broadcasting, and 12 fax-on-demand mailboxes, **Bogen Communications'** FaxFriday resembles a cable-TV connection box and works with a phone, fax machine, or PC modem. It can store up to 180 pages of text or 36 minutes of digital recording, depending on configuration, and is available on the street for approximately \$600. 201-934-8500.

The **GLoria**, available with either a 4MB or 8MB VRAM frame buffer, also provides 8MB of DRAM, which gives the GLint chip an additional 32 bits of pixel depth for 3-D processing. While the Vision968 enables existing 2-D drivers to run without modification, the GLint chip lets users accelerate any 3-D application using the OpenGL API with almost no configuration. The GLoria also supports the 3DR, 3D-DDI, Renderware, and Reality Lab APIs. Registered users can upgrade all drivers for free for three years via the ELSA support BBS.

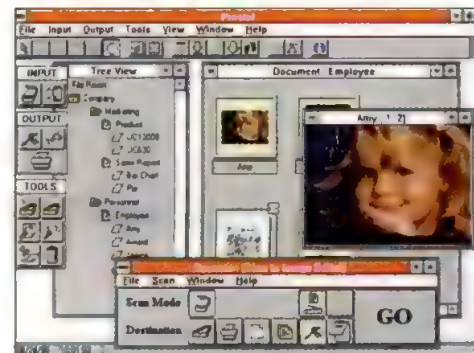
ELSA GLoria. List price: With 4MB of VRAM, \$2,990; with 8MB, \$3,490. ELSA Inc., Santa Clara, CA; 408-565-9669.

Circle 411 on reader service card

Free OCR Software? It's Not Magic, It's Presto

For a limited time, you can download a free version of **Envisions Solutions Technology's** new \$149 Presto optical character recognition (OCR) package from *PC Magazine's* Web page (<http://www.ziff.com/~pcmag>) or from *PC Magazine's* Editorial Forum on CompuServe. Designed with ease of use in mind, Presto provides one-click scanning, copying, and faxing capabilities and comes with its own image-editing program for handling scanned photos.

You can work in black and white, gray scales, or 24-bit color, and Presto allows you to scan a page directly into your word processor. The software's JPEG and CCIT Group 4 compression algorithms minimize file sizes, while multiple "voting" OCR engines maximize accuracy.



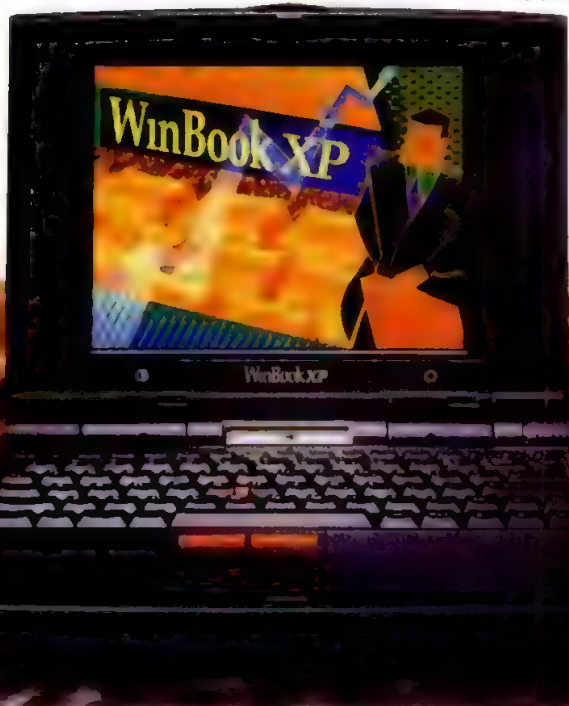
ABRACADABRA! Scan documents directly into your word processor with Presto.

Presto. List price: \$149. Envisions Solutions Technology Inc., Burlingame, CA; 800-436-4360; fax, 415-692-9061.

Circle 414 on reader service card

"...the new top dog..."

PC World—May, 1995



and the 4X CD-ROM Docking Station is leading the pack at only **\$399!**

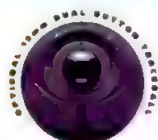
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- INTEGRATED DUAL-BUTTON POINTING STICK, OPTIONAL DUAL-BUTTON 19MM TRACKBALL OR OPTIONAL DUAL-BUTTON TOUCHPAD
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Because the BJC-70 Color Printer is going to be giving you all kinds of new ideas.

Canon



*Sharp, fast,
brilliant colors
and true
blacks.*

Now That's Cheap!

V.34 is everywhere, and as a result, lower-speed modems are getting less and less expensive. But in the case of the new MVP144I from **Cardinal Technologies**, we're approaching bargain-basement pricing. Expected to sell on the street for around \$55, the internal MVP144I faxes and transmits data at 14.4 Kbps and comes with communications software and free trial subscriptions to the major on-line services. An external version, the MVP144XF, should sell for around \$69.

Cardinal MVP144I. Estimated street price: \$55. **Cardinal Technology Inc., Lancaster, PA; 800-775-0899, 717-293-3000; fax, 717-293-3055.**
Circle 413 on reader service card

High-End Hydra Hits The Market

Mita Copystar America has introduced the multifunction Mita AF-1000, which doesn't require users and small workgroups to sacrifice performance for the convenience of having an all-in-one office machine. The AF-1000 produces 12 photocopies per minute and can reduce or enlarge documents from 50 to 200 percent in 1 percent increments. The unit's internal 14.4-Kbps fax hub transmits documents at 10-ppm, while the model scans and prints documents at 400-dpi resolution, supporting 128 levels of gray scale. It



PLEASE REMAIN SEATED: The AF-1000's optional serial interface lets you fax from your PC.

comes with a 50-sheet automatic document feeder for letter-, legal-, or ledger-size paper and an 11- by 17-inch flatbed scanner. The AF-1000 comes with a 250-sheet universal paper drawer and the standard 1MB of memory (upgradable to 5MB). The unit also includes Mita's Encryption Mode, which allows faxes to be "scrambled," and they can only be decoded when a user's private ID code is entered.

Mita AF-1000. List price: \$5,995. **Mita Copystar America Inc., Fairfield, NJ; 800-222-6482; 201-808-8444.**

Circle 415 on reader service card

SOFTWARE BRIEFS

Now shipping from **Bentley Systems** is a full-featured 2-D and 3-D CAD package called **MicroStation PowerDraft**. The package's **AccuDraw** feature reduces unnecessary keystrokes and mouse clicks, making your work more efficient. **PowerDraft** lets you work in up to eight resizable windows at once, and the **MicroStation Development Language** and support for programmable macros lets you automate tasks and develop applications that integrate with **PowerDraft**. 800-778-4274, 610-458-5000.

Jensen-Jones has introduced Release 3.0 of its information manager, **Commence**. The \$295 Personal version adds to its calendaring, scheduling, and contact-managing capabilities the ability to filter viewed information based on user-definable parameters, and it can now process incoming e-mail as it enters the program. The \$395 Workgroup version adds the ability to synchronize a client PC with other machines on a network. 800-688-7080, 908-530-3434.

The \$99.95 **QuickXpense** from **Portable Software Corp.**, now in Version 1.5, allows you to "prepopulate" your expense reports by letting you download a list of recent credit-card transactions from an on-line service directly into the software. This latest version includes 25 new expense-report forms, and its **Xpense-Xpress** feature set uses the **Quicken** Interchange Format to let you import from and export to a third-party personal finance program. 800-626-8620.

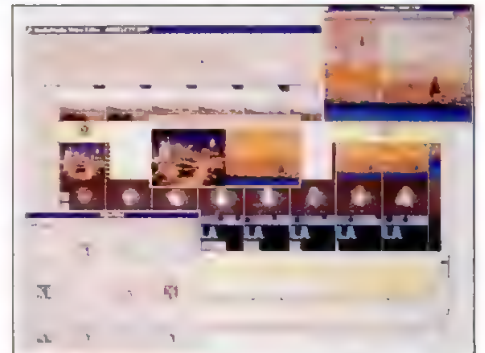
Designed for use in the legal industry or in any business where task-based billing is done, the \$95 **DTE 4.0** for Windows from **Advanced Productivity Software** now provides up to six different definable task code fields that can be hierarchically linked. Network administrators can assign up to five levels of access rights to networked users, and the **DTE TimeSaver** timer and entry system lets you start, stop, and pause timers while in any Windows application, keeping a second-by-second account of the tasks you spend time working on. 800-783-9231.

The **Business Planning Advisor**, Version 2.0, from **Enterprise Support Systems**, helps you create a business mission, define goals, and devise strategies. You can project the financial consequences of your plans with multiyear statements and create tailored planning documents. 404-441-3190.

Single Step Multimedia

Providing a complete solution for entry-level multimedia developers, **MediaStudio Pro**, Version 2.0, from **Ulead Systems** is a suite of separate video, audio, image, and morphing editors. New to this version is the **Multimedia Converter**, which lets you convert virtually any type of multimedia file format into any other. You can change file attributes, such as color level, size, compression, and frame rate during the conversion process. Batch-mode conversions are also possible.

Other new features include antialiased titling; support for 2-D and 3-D moving overlay paths



CH-CH-CH-CH-CHANGES: MediaStudio 2.0 now does batch file conversions.

and mapping to a cylinder or sphere; and the **F/X Studio**, a library of effects filters. An on-line guided tour and interactive tutorials get you started. **MediaStudio Pro, Version 2.0.** List price: \$349. **Ulead Systems Inc., Torrance, CA; 800-858-5323, 310-523-9399.**

Circle 416 on reader service card

Files from Near or Far

The **Remote Document Server (RDS)** included in **Novell's SoftSolutions 4.1** document-management system lets you search, retrieve, import, forward, and even fax files located on your company's home server from anywhere you can send and receive e-mail. You simply send a message containing search criteria, retrieval requests, or other commands to an e-mail address specified for **SoftSolutions** communications. The **Remote Document Server** replies to you with the results of your search, a requested file, or a report of your processed command. Download a document from the network onto your notebook in your hotel room, edit it, and send it back. While you have the file, **SoftSolutions** marks it as "In Use" and does not allow other users to access it until it is returned.

SoftSolutions 4.1. List price: \$495 per server; \$295 per workstation. **Novell Inc., Provo, UT; 800-861-2507.**

Circle 429 on reader service card



Here's Something You Don't See Everyday

Introducing the new DeluxScan™ family of high-resolution digital monitors from Hyundai. In 15, 17 and 21-inch screen sizes. Each one packed with the kind of features — and value — you don't see every day.

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DeluxScan 17	17"	0.28	1280 x 1024	✓
DeluxScan 17 Pro	17"	0.26	1600 x 1280	✓
DeluxScan 21	21"	0.28	1600 x 1280	✓

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CIRCLE 170 ON READER SERVICE CARD

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DISPLAY PRODUCTS

Banana George Blair is 80 years young.

* EPA Energy Star, MPR II and DPMS
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— PC Magazine

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May 30, 1995



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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

A Fresh, Fictional Take on Life Inside Microsoft

BY RICK AYRE

Despite the fact that Douglas Coupland gained quite a bit of fame from his first novel, *Generation X*, many readers of *Wired* didn't realize that his contribution to the magazine's January 1995 issue, "Microserfs," was fiction. Its accuracy and sharp-eyed detail made them think they were reading an insider's exposé of life

behind the evergreens at Microsoft. In fact, they were.

This very funny and thought-provoking story, now expanded

to novel length, will make you look at life in front of a computer screen in many new ways. Are we already slaves to our computers and our computer-driven society, or are computers tools of redemption that we'll eventually use to elevate ourselves to a higher level? That's the question Coupland grapples with.

The story begins at Microsoft, where a group of young programmers are under the gun. Their leader even receives a dreaded flame mail from Bill Gates himself. Says one coder, "We figured

it must have been a random quality check to keep the troops in line. Bill's so smart. Bill is wise. Bill is kind. Bill is benevolent. Bill, be my friend. . . Please!"

All six of the twenty-something programmers Coupland tracks struggle to get real lives and struggle against themselves. In the course of the story, they manage to free themselves from Microsoft (they quit), IBM (they're laid off), and Apple (they wait for furloughs). Eventually,

they start their own software company in the Silicon Valley rec room of one of their parents and hope their great idea will attract a fat buyout.

Once on their own, though, the pressure's still on. Working 16 hours a day, they take breaks only to visit the parking lots of other Silicon Valley software companies to see which ones are full on evenings and weekends (those will inevitably be the companies with the hottest products).

What Coupland does bril-

liantly, as he did in all three of his earlier novels, is give us a view from the inside by letting his characters talk and talk until we feel like we're part of the group.

Microserfs is fiction, but much of it is true as can be. Just ask anyone who's ever programmed for a living, been to the Consumer Electronics Show, or tried to start a software company.

Microserfs, by Douglas Coupland, \$21.00. Harper-Collins, 800-331-3761; ISBN: 0-06-039148-0.

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To read an excerpt from *Microserfs* or an interview with Douglas Coupland <http://www.ziff.com/~pcmag> or type GO EDITOR at any Compu-Serve! prompt.



Unmasking Multimedia

BY ALFRED POOR

Multimedia Demystified is one of those books that's a useful reference but falls a little short of its promise. It is an ambitious effort that attempts to place the interactive content and interwoven structure of multimedia computer products on the printed page.

The book is sponsored by Apple Computer, and (as might be expected) there is a strong bias toward the Macintosh platform. The overall goals of the book are independent of the type of computer, however, and whether you are developing a commercial product or an in-house training program, the book contains a lot

of valuable information.

Content is divided into Roles, Projects, Process, and Resources. Roles describes the different parts people play in the development and delivery of a multimedia project, recognizing that individuals often wear many hats. Projects describes the kinds of products that can be created, and Process covers the steps required to conceive, create, and deliver a product. Resources has lists of books, magazines, and organizations.

A great deal of effort was spent on the visual design of the book; its colorful pages look more like a magazine than a typical text. Sections are color-coded, and sidebars are liberally sprinkled about the pages, including interviews with industry insiders and case-study overviews of specific projects. There are also plenty of lists, tips, and checklists for different topics. If you are think-

ing about a multimedia project, there is no doubt that you can learn a great deal from this book.

One problem with the book is that its organization is inconsistent and confusing in places. For example, the Projects section contains some items that are products (corporate training programs or electronic books) and others that are delivery methods (such as kiosks), and the overlap between these can be confusing.

Multimedia Demystified won't teach you everything you'll need to know to create your first multimedia project, but if you view it as an introductory textbook to familiarize you with the basic

concepts, you won't be disappointed. It's a great place to get an overview, and you'll have a good foundation on which to build your knowledge and skills. **Multimedia Demystified**, \$30.00. Random House Electronic Publishing, 800-793-2665; ISBN: 0-679-75603-5.

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READ ONLY RECOMMENDS



If you're thinking about creating 32-bit sprite-based animation, then you must read Nigel Thompson's *Animation Techniques in Win32*. A CD-ROM containing the source code is included for the example applications.

\$34.95; Microsoft Press, 800-677-7377; ISBN: 1-55615-669-3.

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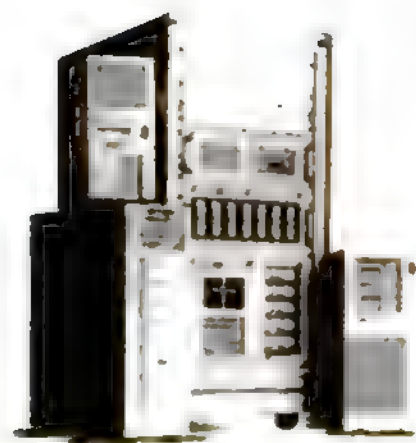
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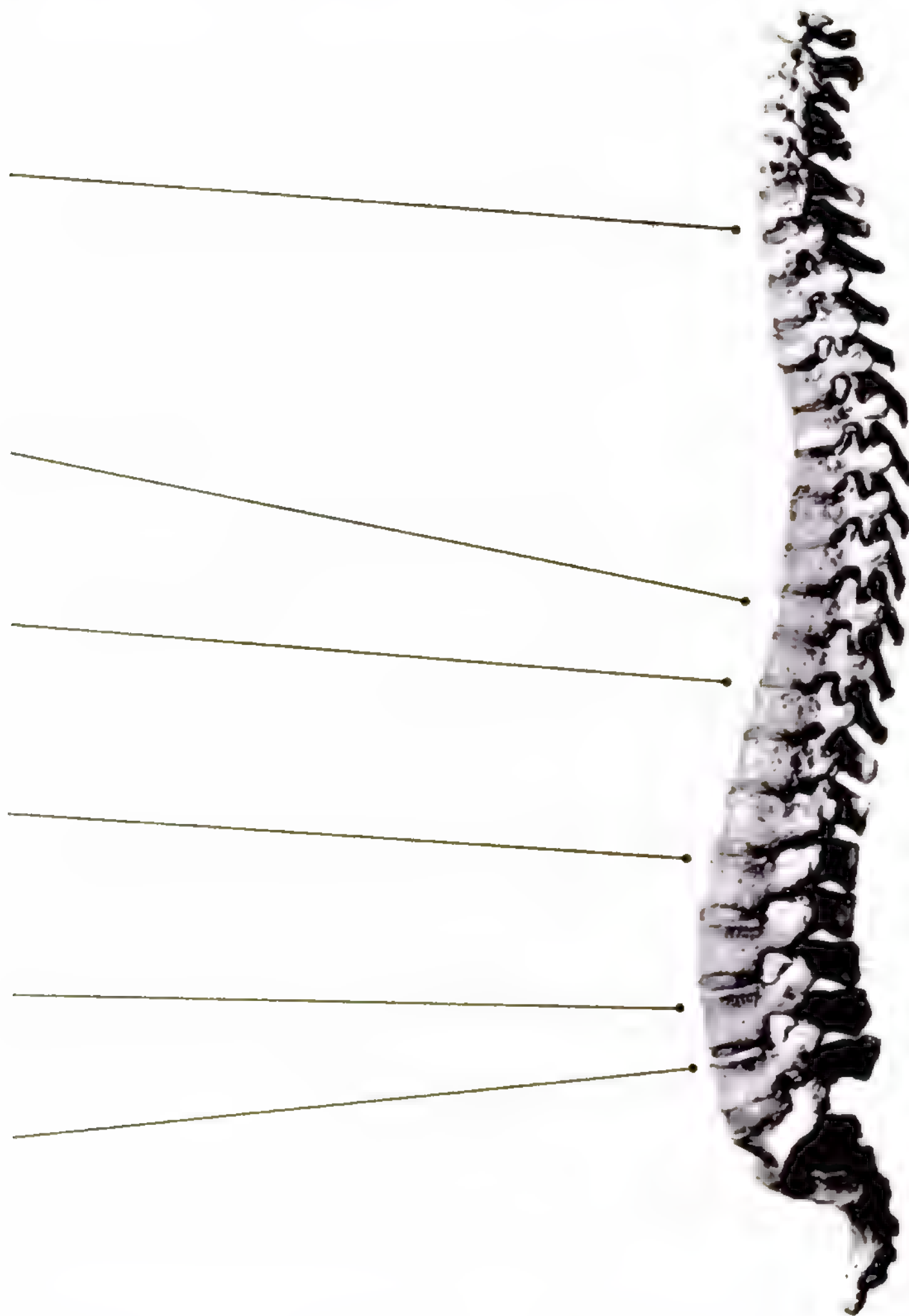


Fig. 1 Backbone

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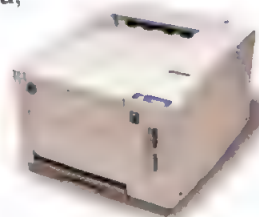


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Michael J. Miller

Perceptions of Perfection

Another year has come and gone, so it's time once again to list our specifications for the Perfect PC. And just like last year and the year before, we find ourselves asking for the same things: machines with faster processors, more memory, better graphics,

and bigger hard disks. Because the PC industry moves so fast, we expect to see most of these features delivered at reasonable prices in the year to come. Next year, we'll do it all over again.

How ironic it is, then, that despite the fact that year in and year out we keep getting better products for our money, many people are still complaining that PC technology moves too fast.

STARING A GIFT HORSE IN THE MOUTH

Ever since Bill Machrone's silver spade dumped the first shovel of dirt on the 286 and ushered in the age of the 386SX back in 1988, it's been the same song each year: "Why can't the PC business just stand still for a little bit, so we can catch up?"

I heard the same lament again a year ago when we sounded a death knell for the venerable 486 and hailed the Pentium as its successor ("The 486: A Final Requiem," May 17, 1994). I'm sure I'll hear the same complaint coming from people again this year. After all, our "entry-level" Perfect PC is a 75-MHz Pentium with 8MB of RAM and a 720MB hard disk.

"Why do I need all that power in an entry-level machine?" some people will ask. Or, as one reader asked recently, "I bought a 486/33 last year; does this mean it's obsolete?"

The basic answer, of course, is that you're foolish to buy anything less than a 75-MHz Pentium. If you do, you won't save much money, and your system will become obsolete that much faster. Now, that doesn't mean that your old 486/33 is obsolete; as long as it still runs the applications you want it to run, there's no problem. But because of the demands of some of today's applications—and in anticipation for tomor-

row's software—one day soon you'll probably want a machine with more capabilities.

GIVE THE PEOPLE WHAT THEY WANT

Why do software vendors keep adding new features, making their products bigger, and requiring faster and larger machines to run them quickly and efficiently? The answer is actually quite simple: because we want new features. We want operating systems like OS/2 Warp or Windows 95; and when given the choice, we're quite willing to buy enormous suites of applications that can easily fill 100 MB or more of hard disk space, rather than just a single application or two.

Lately, I have found that some of my colleagues have been calling for software vendors to stop adding features to their programs and instead concentrate on fixing bugs and making sure everything is compatible with every single piece of hardware, peripheral, or other software ever shipped. You've got to be kidding!

Yes, I think that software and hardware companies need to pay more attention to compatibility issues. But I think we're a bit spoiled, because in general, the industry has done pretty well considering the tens of thou-

sands of titles and hundreds of thousands of different configurations available in today's computer market. It's certainly a better situation than you find in the home game machine market, where every evolution of Sega and Nintendo requires both new hardware and new software.

Others say that if hardware advances stopped, software developers would concentrate on writing smaller, faster code that worked on older machines. There's probably some truth in that as well, but, as it is, developers have a pow-



Why are so many people upset by the rapid innovation that brings us such great new products?

Michael J. Miller

erful incentive to make sure their products work on older machines, because that's where they sell most of their upgrades.

I want compatibility. I want fast applications. I want bug-free programs. But I also want new features.

I find Microsoft Word for Windows 6.0 and WordPerfect for Windows 6.1 easier to use and more powerful than WordPerfect 4.1 or WordStar 3.3. When it comes to spreadsheets, I like things like Microsoft Excel's Pivot Table and Lotus 1-2-3's Version Manager. The QuickTask integration in PerfectOffice 3.0 is simply wonderful. New groupware applications, like Lotus Notes and videoconferencing are already changing the way people work, and I still have a long list of new things I want software to do for me that I haven't seen yet.

In fact, as hardware and software companies improve the availabilities of their products, I find myself wanting things I hadn't previously thought about. Now that's not to say that I find every new feature useful. I have yet

to see a grammar checker that is worth the effort. I also don't think that the need for integrating mapping with a spreadsheet is very widespread, but that doesn't mean there aren't people who want these features. I certainly don't begrudge vendors who add features I may never use to software that I do use.

GOOD FOR THE GOOSE, BETTER FOR THE GROUP

I'm looking forward to the day when I see machines fast enough, networks robust enough, and applications smart enough to make working together in group environments much better, to make desktop videoconferencing practical, and to provide multimedia experiences like I've never seen before. Will this mean new versions of today's applications? Will this mean completely new applications? Will some of those applications require new machines? Yes, yes, and yes.

That's just the way it is. You need to buy machines you can justify with today's applications, but there will always be new applications available. Some will work much better if you just do a relatively small, reasonable upgrade, such as adding more memory or a larger hard disk. And some will

work on the machine you have. Some will work much better on a new machine. That's why I always try to buy a machine with a little bit of headroom. If you buy something that just barely runs today's applications, you'll find yourself needing a new machine that much sooner.

So when I look at our selections for this year's Perfect PC, I don't feel bad about the machine I bought last year or the year before. I still use those machines, only now in different capacities.

I look at the machine currently on my desk or in my briefcase and think about how much use I get from it and how much better it is than what I had before.

I know, however, that there are things I still can't do with my PC that applications currently under development will let me accomplish in the near future. Will this be the best PC to run those applications? No, it won't be, and if I want the latest features, I'll have to buy a new system.

Will that computer be faster, bigger, and more powerful? Yes, and so will the applications. And each year people will lament that this year's state-of-the-art wonder is next year's mainstream machine and a close-out special by the following year. □

1984

point.
click.
drag.
drag.
drag...

1995

point.
tap.
write.
draw.

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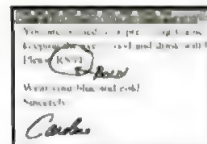
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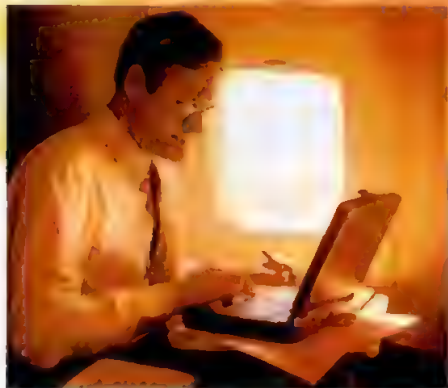
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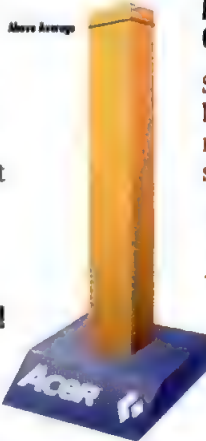
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CIRCLE 034 ON READER SERVICE CARD

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CIRCLE 046 ON READER SERVICE CARD



Bill Machrone

Portable Telephones for Everyone

America's telecommunications industry is teetering on the brink. The FCC has auctioned off billions of dollars' worth of radio spectrum for the industry to offer new wireless services, called PCS (personal communications services). The winners must

now choose the technologies they will use and begin to build the infrastructure of transmitters, switches, and consumer devices. Whatever technology they choose, the system will be digital, with significantly better capacity, compatibility, and privacy.

Europe has had such a system in place for several years. The European standard, GSM, is technologically advanced but for one small problem: It can't be used by hearing-aid wearers. In fact, if hearing-aid wearers come within several feet of a GSM phone, they hear a loud buzzing. If they get closer, the buzz becomes deafening, drowning out even the sound of their own voices.

The problem is well known in Europe. With billions of dollars' worth of infrastructure in place, however, it's too late to change the technology. Modifying the hearing aids isn't a viable solution, either. With the emphasis on small size, light weight, and long battery life, there's virtually no hope for improving the installed base. Even with new hearing aids, the problem cannot be eliminated.

Tragically, hearing aids didn't have to be a problem. GSM is based on a time-division multiple access (TDMA) scheme that causes the cellular phone to send out a pulse of radio-frequency energy 217 times per second. That's what the hearing-aid wearers hear. If the system had been built with another technology, such as CDMA (a lower-power, spread-spectrum technology), or at nonaudible frequencies, the interference would have been greatly reduced.

The chairman of GSM MoU, the oversight group for GSM vendors, has written to FCC chairman Reed Hundt to address the concerns: "Some of the research suggests that a small percentage of all hearing-impaired persons use old, inferior-quality hearing aids, and therefore may be unable to use high-power

digital wireless telephones, whether they be CDMA, GSM, or AMPS-D." The letter suggests that existing hearing aids can be upgraded or replaced but doesn't address the attendant cost issues.

Given what we know about the potential effect of GSM on more than 6 million U.S. hearing-aid wearers, it's unconscionable to pursue this option. Yet BellSouth and Pacific Bell have decided to deploy GSM.

GSM has other problems, too. The power level, combined with the fast rise time of pulses, reportedly causes problems with electronic devices. Sweden bans the phones from its hospitals because they reportedly interfere with pacemakers and electric wheelchairs. A report from an Australian newspaper claims that a GSM car phone set off the car's airbag. One potential plus: GSM phones are said to be able to reset a Parisian taxi meter to zero.

GSM may be a poor choice for mobile computing. I wonder about the potential for confusing the sensitive innards of notebooks or interfering with emergency communications equipment.

American telephone companies are not without alternatives to GSM. NA-TDMA runs at lower power and is tailored to North America. CDMA has been slow in emerg-

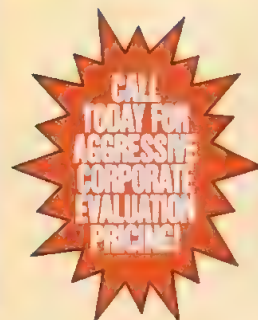
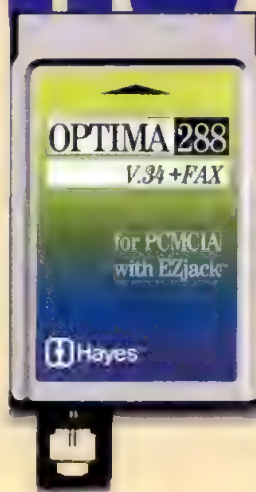
ing from the lab but should be far better for the mixed voice and data services critical to mobile executives.

These technology decisions are irrevocable once the building begins. Cellular phones have always been incompatible with hearing aids; let's not do the deaf another disservice. If you're not concerned about the plight of the hearing-impaired, look at your own situation with enlightened self-interest. If you believe that GSM is not the right choice, let the FCC know (Federal Communications Commission, 1919 M St. NW, #814, Washington, DC 20554). □



PCS telephones will be terrific—as long as you're not hearing-impaired.

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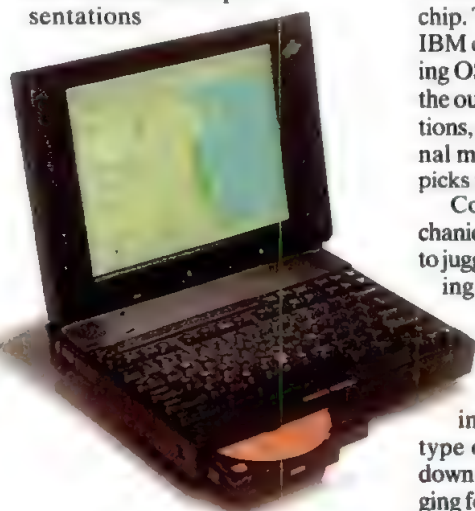


Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

IBM: King of the Portable Multimedia Hill

The ThinkPad 755CD is still the king of the portable multimedia machines. It's big, heavy, expensive, and mostly wonderful. Users appreciate the keyboard, which has a great layout and a feel that belies its thinness. Those serious about multimedia presentations



appreciate features like the ability to plug in a mouse without having to reboot the system. The big TFT color display continues to draw raves, even though it has become more common lately. Most users feel that the power of the machine is adequate, but a few are already clamoring for a Pentium chip. The sound system is good, but IBM embarrassed itself by not having OS/2 support for Mwave right at the outset. If you make voice annotations, you'll probably want an external microphone; the built-in mike picks up too much room noise.

Complaints center around mechanical design issues, such as having to juggle a plastic spacer when switching among the CD-ROM, floppy disk, or hard disk drives, and of course, the easily lost (and mostly useless) cover for the PC Card slots. Given its 2.2-inch height, you don't want to type on a 755CD unless you get it down low. On a desktop, you're begging for sore wrists and fingers.



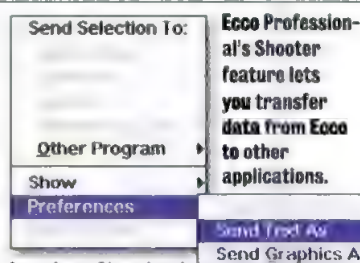
Nothing New About Hot Laptops

I've seen a number of complaints about some of the new laptops that run so hot you either can't rest your palms on the palm rest or, in the case of an AST Ascentia model, close the cover completely while it's in the docking station. The original AT&T Safari, which was an otherwise nice machine, got so warm on the left underside that if you were using it on your lap for an extended period, it would take the crease out of your pants—but just one leg. Oh well, at least I had a ready cure for cramps in my left thigh...

Talk Turns to Ecco

We had asked for information on Lotus Organizer 2.0, which we covered in our issue of May 30, 1995. Every on-line conversation about Organizer, however, seemed to turn inevitably to Ecco Professional. I've come to regard Ecco as the graphical successor to Lotus Agenda: It's replete with features but is a demanding program that rewards the diligent. Users like Ecco's scheduling capabilities and unique features such as the Shooter, which lets you transfer data from Ecco to other applications. They're less thrilled, however, with the outliner and tend to use the outliners in their word processors instead.

For my part, I like the Shooter a



lot, but I've had to use the export feature for names and addresses because of the way Ecco handles them. I vastly prefer Inspiration or even WinWord for outlining. Serious Ecco users keep several views of multiple files open, both on their local machines and on the network. They use the shared files as windows into corporate information, departmental information, and project and workgroup status. Clever use of filtering lets them create to-do and pending folders. The sheer malleability of the product makes it many different things to different users. But it still has some surprising limitations, such as an

inability to enter holidays other than the ones preprogrammed into the product, weak support of color coding, and less flexibility in exporting than most users would like.

Historically, Ecco's authors have been curiously uninterested and dismissive of suggestions for improvements from users and editors alike. Maybe it's not an application program at all but a social experiment or intelligence test.

LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues.

Autodesk 3D Studio	Quad-speed CD-ROMs
Diamond Stealth 64 Video	Verisoft Remove-It
Peachtree Accounting	Toshiba Portégé T3600CT
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John C. Dvorak

Enhanced IDE Marries Fast SCSI

It's the nuttiest business in the world. There are razor-thin margins, cutthroat competitors, technology threats, and doom in the long term. It's the hard disk business, and its players can go from riches to rags and back again. Now there is one more

thing making their lives miserable: competing standards. The wave of new standards and specifications hitting the market is unlike anything we've seen in the past, and the spillover will affect you and me.

It's a mess. Here's a selection of the new acronyms and terms headed your way: E-IDE, E-IDE-95, IDE bus mastering, Fast ATA, ATA-2, ATA-3, ATA-4, ATAPI tape, ATAPI CD-ROM 1.2, SCSI-2, Wide SCSI-2, Fast SCSI, SCSI-3 subset, SCSI-3, Wide SCSI-3, Ultra SCSI, Wide Ultra SCSI, Fast 20, double-speed SCSI. This alphabet soup will be appearing over the next 18 months.

What all this means to you and me is that we have to be much more careful in selecting our next computers, because this confusion of specifications and standards may well adversely affect a system's upgrade potential. The way around this mess is to consider a hybrid system that uses both IDE and SCSI.

Some history. Let's understand this situation by examining the history of the IDE disk drive controller, which replaced the clunky ST-506 standard in 1987 and quickly became the de facto standard. The idea behind the IDE standard for disk drives began at Western Digital and became so popular that it quickly shut out SCSI, which was making a bid for the desktop. As the SCSI folks began to find flaws in IDE, and as drive capacities increased, the IDE specification evolved. The spec is now called Enhanced IDE, named as such by Western Digital marketing executive Rich Rutledge. The other IDE-type drive makers—Seagate, Quantum and Conner (all of which are bigger companies than WD)—came up with their own naming schemes and specifications.

What really confuses things is that the drive makers, the ANSI committee, and a group called SFF

(Small Forms Factors) are all preparing competing specs. SFF is the most fascinating group of the three, since it was originally given the responsibility of standardizing where drive makers put screw holes and connectors. It now has responsibility for specifying the electronics inside.

Some predictions. What does all of this mean? It means you're probably going to have trouble trying to add a second hard disk to that system you just bought, unless it's the exact same disk that came with the machine.

Not that it will be impossible to upgrade a PC in the future. I'm convinced that the key to easy upgrades is going to be SCSI—like it or not. The good news is that since Adaptec promoted the ASPI driver (a universal SCSI device driver) and something called EZ-SCSI, you can make SCSI work without a hassle.

In fact, it's kind of amazing how well things work these days in the SCSI world. The bad news is that SCSI is taking the same turn towards complexity as IDE, with a slew of new, confusing forms of SCSI headed your way. Also, the SCSI people seem intent on attacking IDE (one campaign's slogan is "I-D-E will D-I-E"), rather than establishing SCSI as a partnered standard, which it should be.

One thing's for sure: In the years ahead, machines will come with big and fast Enhanced IDE drives (or Fast ATA or ATA-2 or whichever standard survives). I'd advise adding an Adaptec PCI SCSI Master kit, which includes the AHA-2940 Fast SCSI bus-master host adapter. You should be able to string 7 external SCSI-2 devices off this thing effortlessly, just as if you had a Macintosh.

This is the way things will shape up: internal IDE hard disk and CD-ROM; external SCSI add-ons for expansion. Now you know.



The SCSI people seem intent on attacking IDE—one slogan is "I-D-E will D-I-E."



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CIRCLE 117 ON READER SERVICE CARD

Inside Track

P

Power PC Update Dept.:

It's been quite a while now, and it appears that the supposed next-generation platform, IBM's PowerPC-based Personal Power Systems, has **died on the vine**. It seems the initial idea to run a version of OS/2, which was originally part of IBM's grand operating system scheme called the Workplace OS, simply got caught in **one too many committees**. The same can be said for Taligent, the Apple-IBM Joint venture. And remember Kaleida? Too many committees did these ventures in, too.

So when the Power PC systems finally do come out, guess what operating system you can expect to see: Windows NT. And you can expect these systems to do as well as the rest of the Windows NT line-up. In other words, **zilch**. As one person asked me recently, "With IBM and Apple in the same boat, why don't they simply roll out the Power PC line as Macintosh clones using Apple's System 7.5?"

Meanwhile, IBM's computer division has announced it will **preload Windows 95**. How nice of them.

Bug Report Dept.: Here's a newsletter I can recommend for both good reading and a variety of good information. It's called *BugNet*, and it discusses the most important **new bugs of the month**, listed by product. Along with a description of each bug, BugNet outlines an intelligent workaround. This thing isn't just packed with scads of reports from niche programs, it's full of mainstream-product bug listings. It's a must-have subscription, and I'd advise buying all the back issues you can find. For individuals, it's \$25 a year. Contact BugNet, Box 393, Sumas, WA 98295; e-mail, BugNetMag@AOL.COM.

Another Washington State Newsletter Dept.: So what's going on in the Pacific Northwest that is giving rise to all these outstanding publications? I'm getting flooded with them. I've found *Cybernetics Digest* **essential executive reading**. When I saw Bill Gates on the same plane as I headed for Spring Comdex, I said hello and handed him a copy of it—because **even he could use it**. The authors of this newsletter digest important articles from a laundry list of high technology and business publications. They then present you with well-thought-out summaries—not abstracts—of the articles. At \$24 a year, you'll find it worth every penny and then some. **It's amazing**. *Cybernetics Digest* is published monthly by KFH Publications, 3530 Bagley Ave. North, Seattle, WA 98103; 206-547-4950; fax: 206-547-5355; e-mail, ansen@cuix.pscu.com. This is one of the publications I use all the time to stay on top of things.

*You can expect the
Power PC systems to do as
well as the rest of the
Windows NT line. In other
words, zilch. With IBM
and Apple in the same boat,
why don't they just roll out
the Power PC line as
Macintosh clones?*

Weird Technology Dept.:

Do you need to take gigabytes of data with you on the road to use with a portable PC, or to move to another desktop machine? The amount of data I need to take with me is constantly growing, and it's getting tougher and tougher to squeeze it onto a notebook's hard disk. How about this technology: It employs a thumbnail-size cassette containing a 2.5-mm tape that uses using Sony's **non-servo NT helical scan** technology. The whole package weighs 10 ounces. The drive unit plugs into your PC's parallel port and is powered by two AA batteries. That's the **Pereos tape drive** from Data-sonix (Boulder, CO; 303-545-9500; fax, 303-545-9249).

At \$699, it's not cheap, but this unit is a **stunner**, especially when you realize that this incredibly dinky cassette (smaller than any tape you've ever seen) can hold a whopping 1.2 gigabytes of compressed data. The bad news is that the interface needs a lot of improvements. Still, it works. I backed up my entire 1.2-gigabyte desktop PC's hard disk and took the contents with me to Spring Comdex. I had every last thing I have on my desktop machine right there on my notebook. It takes about 2 to 4 hours to offload a gigabyte from the parallel port—not bad. The inventor of this thing is one of those **superstar engineers** who fled Storage Technology to help make Exabyte the leader in 8-mm backup devices. And now there's this. I'm impressed, and you will be, too.

Own a Piece of History Dept.: A couple of years ago, Tony Cole of Hayward, California, became **the first (and only) citizen to own a Cray-1 supercomputer**. He bought it at an auction, over the protests of the government. Apparently the thing is supposed to be sold only to the military, or who knows what other authorized organizations. Anyway, Tony has taken the printed circuit boards (cards) out of it and is selling them enclosed between two thick slabs of Lucite as collectors items, conversation pieces, or whatever you want to call them. These are probably the only cards from a Cray-1 **ever to be sold this way**, and there are fewer than a thousand available. Each one is different, two-sided, and cool looking. Each original card seems to have been mounted on a 1 1/2-pound copper plate.

Cole is selling them for \$100 each, plus a \$10 shipping fee (they weigh a lot). Each is about 8 by 10 inches. **Grab a piece of history** for your desk or wall while you can. Tony can be contacted at VIPC computers, 384 Jackson St., #1, Hayward, CA 94544; 510-881-1772. This is one unique and **outstanding gift idea** for the techie. **Seriously cool.** □

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Jim Seymour

Don't Get 32-Bitten

Is "32-bitness" by itself enough? Not as far as I'm concerned. And, as I suspect the marketplace will show us this coming fall and winter, not as far as you're concerned, either. Once Microsoft Windows 95 ships, are you and I and 30-odd million others going

to trample down the doors of computer stores and burn up the 800 lines of direct marketers to buy the first 32-bit applications for Windows 95?

I think we're going to be a little more cautious than that. But my view may be in the minority. Editor-in-chief Michael Miller and I got into a spontaneous debate over this the other day at a *PC Magazine* event in Silicon Valley. I said that, given what we've seen so far of the first-generation 32-bit Windows apps, I think a lot of smart buyers are going to hold back and wait for the 1.1s and 2.0s before plunking down their cash.

The Boss thought I was—well, crazy. He thinks the big story of the software business this fall is going to be the explosion in sales of 32-bit applications.

Actually, I think we may both be right. But, ahem, I think I'm more right than he is. Here's why.

First of all, as much as "32-bitness" is to be desired in applications, it's not just the bits, it's what you do with them. And with few exceptions, in both the 32-bit Windows applications that have already come to market (for Windows NT users) and most of the alphas, betas, and Windows 95 previews I've been seeing in developers' back rooms, the use of 32-bitness is pretty feeble.

Real 32-bit apps, for example, ought to execute a lot faster. The ones I've seen don't. And it's not just the alpha-beta gang, which may not scream because they're still full of debugging code; the first shrink-wrapped 32-bit apps now available from Microsoft itself (for Windows NT 3.5) demonstrate the tentativeness of these first 32-bit efforts.

Have you tried 32-bit Microsoft Word for Windows? A fine word processor, to be sure, but not better—and certainly not faster—than good old 16-bit Word for Windows. Ver-

sion 6.0c. A great 32-bit word processor will use multithreading in Windows 95 to go off and run lots of little subsidiary tasks, invisible to the user, making the program much faster. This one doesn't.

In fact, so far I've seen few 32-bit Windows 95 apps that offer significant performance improvements over their 16-bit predecessors.

They're coming, to be sure. I think the new class of Win32 apps that will run under Windows 95 and Windows NT 3.5 will redefine our expectations for software, delivering both more performance and more smarts in the process. (I like many things about OS/2 Warp, but my skepticism that IBM will succeed in getting these new Win32 apps running under Warp any time soon keeps me from recommending that users move to OS/2.)

The great 32-bit Windows apps are not here yet, however, and I don't expect them to be available for some time after Windows 95 ships. Ergo, bide your time and avoid premature, no-gain 32-bit upgrades.

On the surface it seems logical that the minute people install Windows 95, they're going to want 32-bit apps to exploit that new operating system fully; no one, the cliché goes, ever bought an operating system to use by itself. But

the rules of the game change with Windows 95—just as they already have with OS/2 Warp and Windows NT 3.5.

All three operating systems deliver very useful improvements on their own. In the case of Windows 95, you can expect far fewer episodes of running out of system resources. You get very good Plug and Play help, including better-than-I-expected PnP-style help with configuring many legacy hardware cards. You get a much better interface—one that looks better to me every day I use it. You get access to more memory (if you can afford it). You get



*I've said it before:
1996, not 1995, will be the
Year of Windows 95.*

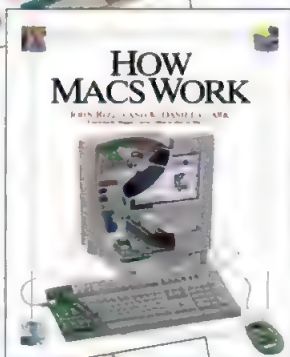
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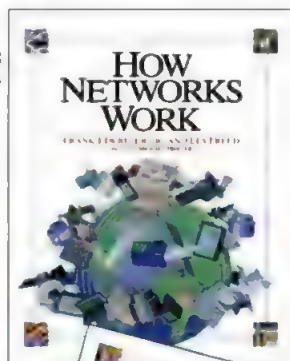


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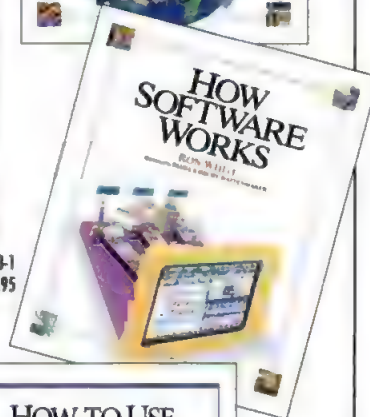
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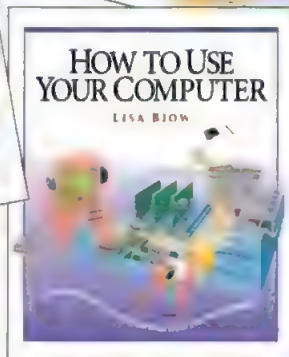
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Jim Seymour

superb network-client tools. You get long filenames—or at least you get them when you also upgrade to Win32 apps.

In other words, Windows 95 is one of the few operating-system upgrades I can recall that offers enough advantages on its own to make the switch worthwhile, even if you continue to use your present apps for some time.

I said I think Michael and I may both be correct; let me explain.

I agree that there will be very good sales of some of the early Windows 95 apps, whether their putative 32-bit advantages are worthwhile or not. Some corporate buyers see the move to Windows 95 and to 32-bit versions of primary apps (often the Microsoft Office bundle) as two sides of the same coin; they'll buy and migrate to both in tandem. And many users will shop around in the early 32-bit-apps market once they've installed Windows 95 and begun to work with it.

So yes, software sales will certainly pick up this fall. That's healthy for the PC software business, which has been in the doldrums for more than a year while we waited for Windows 95 to ship. Software houses have been hurting financially, their sales slipping as we waited. Many finally felt compelled, for revenue reasons, to crank out one more upgrade of their 16-bit Windows apps, even when the advantages of those upgrades were slim indeed.

Michael's right: There will be an uptick in sales of Windows applications. But sales of 32-bit apps aren't really going to explode until next spring. By then publishers that release very early 32-bit apps this summer and fall will have much better versions for sale. And those that ship their first 32-bit products around the time Windows 95 goes on sale will be rushing their second versions to market.

I've said it before: 1996, not 1995, will be the Year of Windows 95. That shouldn't be surprising, and it's not a knock on Microsoft. Changing OSs is a wrenching decision with many consequences for PC users and even more for IS managers. It thus demands careful consideration and a lot of time for testing and evaluation.

The era of 32-bit applications is going to be a watershed for the PC business and for PC users. You won't miss the game by waiting a few months to upgrade your applications. □





Bill Howard

What the Letters Mean

Getting an A on *PC Magazine's* Service and Reliability survey just got tougher. It's the result of an important change, and we want you to know what we did: We included a measure tracking the number of repairs in the first year of service.

PCs have become less different in terms of raw performance, features, and price, although they're still far from being commodity items. Users want to know more about the areas where vendors truly differ: reliability, service, and support. For that reason, *PC Magazine* surveys subscribers. Along the way, we've learned a lot and fine-tuned our methodology.

Our Service and Reliability questionnaire asks readers more than a dozen questions. For the previous five surveys, we determined vendor grades based on ratings in three key areas:

- satisfaction with the overall reliability of each PC;
- satisfaction with experiences in repairing each PC;
- satisfaction with each PC's technical support overall.

The readers' ratings in these three areas yielded the A, B, C, D, and E summary grades we reported, which gave you a quick take on each vendor. To get an A, a vendor had to have above-average scores on each of the three measures. B was a combination of average and above-average scores, C was all average, D was a combination of average and below-average scores, and E was all below average.

In our current survey ("Service and Reliability: Are You Getting What You Need?"), we've added a question that *directly* measures repair experience: How many times did each desktop need repairs in the first 12 months of use? (That's in addition to asking about satisfaction with overall reliability as measured on a 1-to-10 scale.) Those four questions now determine the summary grade. To receive an A, a vendor must receive scores of above average on all four measures. Among desktop PC vendors, the ranks of those receiving an A thinned to four: Compaq, Digital, Hewlett-Packard, and IBM.

Dell, Gateway 2000, Micron, and ZEOS, which

had A's the last time we surveyed, all had average scores on first-year repair experience; so this year, each receives a B. Among portables, Compaq continues to receive an A, and Toshiba moves up to an A. Apple/Macintosh, Gateway 2000, IBM, and TI now receive B's. And just as the ranks have thinned at the top, so have they at the bottom: Only one vendor still has an E rating (CompuAdd in notebooks).

For each measure, we report both a numeric score and a color-coded indicator for *significantly better than average*, *average*, or *significantly worse than average*. You'll note that some average scores appear to be better than the overall average.

Take Micron, for instance. For first-year repair experience for desktop PCs, the average is 28 percent—meaning 28 percent of a typical vendor's PCs need repairing in the first year. Micron's score was 25 percent, seemingly better than average. But the score wasn't different enough from the average, statistically speaking, to make *PC Magazine's* research department rate Micron as significantly better than average. In other words, *average* means two things: statistically average, no questions about it; or not clearly different enough from the average.

For those of you who hate hearing Muzak while on

hold waiting for tech support and who hate waiting for the repair truck to arrive, we've added other information. For each vendor, we now report how long it took to get through to a human being (average for desktop vendors: 9 minutes); how long the call took, including time on hold (11 minutes); how long it took for the vendor to call you back (7 hours); and how many days it took to get a PC repaired (5). These are secondary questions; they aren't part of the Readers' Report Card grades, but we think they're immensely interesting. □



Vendors now need to work a little harder to get an A on our Service and Reliability survey.

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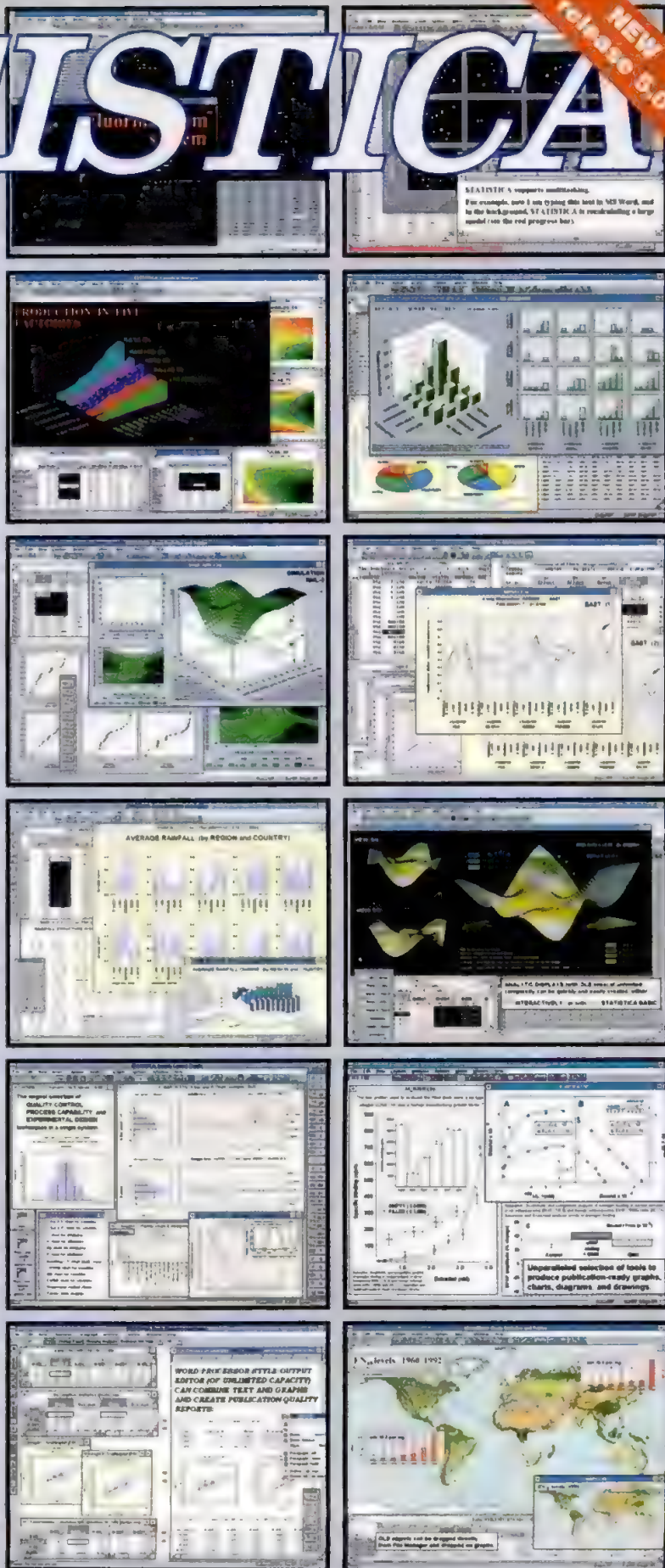


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NETWORK EDITION

COVER STORY

IP/IPX INTERNET GATEWAYS

Hassle-Free Internet

Here's how to give your NetWare users access to all those great Internet resources—minus the complications.

By John Garriss

It's as if they were never meant to talk to each other. Novell's NetWare, the king of local-area networking, runs over the IPX protocol, while the ever-expanding Internet was built around the TCP/IP protocol suite. This can cause problems for NetWare administrators who want to give their users access to Internet resources.



Photograph by Neal Farris



Talk about a white-hot topic: the Internet, of course. And the frenzy shows no signs of letup. But while it may be cool for users, it's just one more headache for network managers. (I wonder if they're beginning to feel like air traffic controllers—with packets and cells crowding their screens instead of airplanes.)

WE'VE GOT YET ANOTHER slice of the Internet access market in our cover story. We couldn't help it. These Internet gateways caught our attention because they clearly have something for everybody. They're a good way to give users access to the Internet without giving the Internet too much access to users.

Just four issues back we reviewed Internet servers—boxes that let your company set up a server and publish information—something that outside Internet users would access. Internet gateways are intended only to provide your users with a pipeline to tap into various resources out there.

COMING BACK DOWN to terra firma, we've got a first look for you on Palindrome's almost completely revamped Backup Director—and it's really good. Palindrome products have pulled in the Editors' Choice in our last two major roundups on backup. Backup Director 4.0 would have been a hot contender for that prize in our Network Edition cover story just two issues back. Network backup vendors have been paying much better attention to delivering the goods without the trouble.

DO YOUR UNIX USERS feel left out? Check out WinDD from Tektronix. It gives Unix users a slick way to run Windows apps in native mode. And we've got one of IBM's first jumps into, what else, the Internet access market, with the Internet Connection for Windows.

—Gail Shaffer

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In PC Magazine's latest Service and Reliability survey, Micron received the highest scores in all four categories: Satisfaction with Reliability, Satisfaction with Repair Experience, Satisfaction with Technical support, and Future Likelihood of Buying. (PC Magazine--January 10, 1995.)



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DIGITAL	8.2	7.8	7.9	6.6
GATEWAY	8.6	8.0	7.4	8.2
DELL	8.4	8.0	8.1	7.8
IBM	8.2	7.6	7.4	6.5
COMPAQ	8.4	7.7	7.7	7.4
HP	8.4	7.8	7.7	7.1



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The traditional approach has been to load separate TCP/IP software on each client system, which can be difficult and time-consuming. In this article we look at one alternative that can make things a lot simpler: using an IP/IPX Internet gateway. With any of the products reviewed here, your users can run all their favorite Internet applications over standard NetWare client software, with the gateway handling all your Internet-based TCP/IP traffic.

The four products we reviewed do most of the hard work for you. We looked at Internet Junction's IJ Passport, Performance Technology's Instant Internet, Internetware's IWare Connect, and Firefox's Nov*ix for Internet, Version 2.21. Each product has appealing features, but Nov*ix for Internet earned our Editors' Choice as the most complete solution of the group.

Note that this product class is relatively new. Except for Nov*ix, these are 1.0 releases. You can expect to see upgrades and new feature sets soon in this quickly growing market.

CENTRAL ADMINISTRATION

Perhaps the biggest advantage of a gateway is its simplified, centralized configuration. You configure a single TCP/IP address at the gateway system for all users on your network. By comparison, using traditional client-based TCP/IP packages, such as SuperTCP Pro, from Frontier Technologies Corp., or Chameleon, from Net-Manage, you need to load TCP/IP software and assign separate IP addresses on every client system.

With the products here, clients communicate with the gateway using NetWare software, and all TCP/IP requests coming from your client applications are actually executed on the single gateway computer. Because all of the TCP/IP configuration is done at the server, you greatly reduce the time it takes to get your users connected.

Probably your single most important decision is choosing where to house the gateway. This is particularly critical with the two NetWare Loadable Module (NLM) solutions here, IWare and Nov*ix. (Instant Internet is a standalone hardware/software solution, and IJ Passport runs only on a Windows 3.1 or Windows NT 3.5 system.)

For the NLM solutions, your choices are to install the software on one of your working file servers or to set it up on its own dedicated hardware. We recommend the latter for two reasons. First, you're liable to have heavy traffic on and off of that server, and you don't want to bog down your nor-

Nov*ix for Internet

Users everywhere are clamoring for access to the Internet. Network managers everywhere are looking for easier ways to deliver it. In this roundup

of Internet gateways for NetWare networks, we found that Nov*ix for Internet does the most complete job of pleasing both users and network managers. Users get a full set of applications; network managers get a solid set of management tools.

Nov*ix installed pretty well, and all of its Internet applications worked with no problem. It also offers some built-in scalability that the other products here do not: Its TCP/IP

stack can service multiple IP addresses, in case you need to configure some individual users or groups, or on the chance you want to establish a Web or FTP server. We do, however, recommend that you install it in a separate system. This increases the total cost of the solution.

We also give an honorable mention to Instant Internet. We especially like the all-in-one-box approach. Configuration was easy, and its applications are adequate.



mal network traffic. Second, it's a lot easier to troubleshoot a system that has only a couple of NLMs running than one that has several—including your production applications. A separate machine simply makes for a cleaner solution. What this means, of course, is that you'll need to factor the cost of a healthy machine into the cost of these solutions.

Another advantage to a central gateway is security. It's really an inherent consequence of the architecture: If there are no TCP/IP stacks loaded at the clients, it's nearly impossible for outside intruders to get into those devices and wreak havoc. You can easily configure these products to let your users run Internet applications—such as e-mail and World-Wide Web client software—while you simultaneously filter incoming requests from the outside world.

The four products are different architecturally, and only Instant Internet works over either a dial-up line or over a router for higher-speed connections (see the diagram "How To Connect to the Internet"). If you connect your users over a modem line, you'll hit performance bottlenecks quickly when you go beyond a couple of concurrent users. But if you have a larger network running over a leased-line connection, the processor speed of your gateway system will become a more important consideration.

APPLICATION SUITES

At minimum, we wanted to see each package bundle an e-mail client, an FTP client, a newsreader, and a Web browser. Instant Internet bundles exactly those applications, while Nov*ix adds Gopher and tel-

net client apps as well. IWare and IJ Passport don't ship with any applications, a testament to their Version 1.0 status. Both companies say that client application suites will be coming soon.

You may want to run your own applications anyway. Each of these products supplies a client DLL that lets you run any Windows TCP/IP-based application conforming to the Winsock 1.1 specification. These days, that includes most of the stable shareware on the market, as well as the hottest Internet application around, Netscape 1.1, from Netscape Communications. But although we expected all of our Winsock applications to work with all the Winsock DLLs, we ran into a few quirks during testing, which led us to question the sanctity of various Winsock implementations.

Moreover, the arrival of Windows 95 may change the Internet application market substantially. Because Windows 95 will include a TCP/IP stack, we anticipate many TCP/IP stack vendors will add Winsock-compliant application suites to their product line (see the sidebar "Plugging In to Winsock").

BIG BROTHER SYNDROME

Because all of your users' Internet requests get funneled through a central system, these products give you the ability to trace all your users' Internet activity. You may learn a lot more about your users than they ever wanted you to know, but you'll be able to regulate your LAN's Internet access efficiently. In practice, we found that both IWare and Nov*ix do a good job logging user statistics, while IJ Passport and Instant



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CIRCLE 934 ON READER SERVICE CARD

An Internet Server or Gateway?

You've probably heard the term *Internet server* in recent months and may wonder whether the products reviewed in this article fit into that category. For the most part, the answer is no, they don't. The products here are *Internet gateways*. The distinctions, however, between the two product types may begin to disappear in the near future.

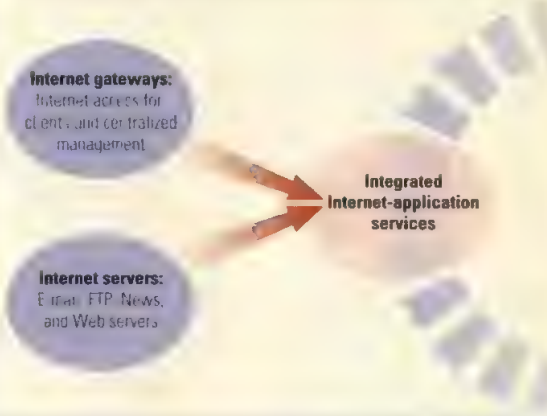
We call these products *gateways* because they handle all the translations between IPX traffic on your LAN and TCP/IP traffic on the Internet. In so doing, they give your users access to common *client* Internet applications, such as Web browsers and e-mail readers. But aside from protocol translations and basic management features, an *Internet gateway* computer runs no specific *Internet server* applications.

Internet servers, on the other hand, provide the server applications that users from other locations access when they get onto the Internet. Some common types of Internet servers are e-mail servers, FTP servers, News servers, and World-Wide Web (Web) servers. Internet servers typically run on Unix systems, but other platforms, such as Microsoft Windows NT, are gaining popularity.

While most commercial Unix boxes have the software necessary to set up most Internet server applications, these services can be difficult to configure. In recent months products have been introduced that help simplify the process—such as the Sun Netra I5 Internet Server and the BBN Internet Server. We reviewed this new crop of plug-and-play Internet *servers* recently

Integration to the Net

In the future, we expect to see gateway and server functions combined to provide single-box Internet-application services for your users.



in Network Edition (see "Publish or Perish?," May 16, 1995).

In most cases, the gateway products reviewed here complement rather than compete with Internet server products. It's perfectly reasonable, for example, to set up a gateway to give your clients access to Internet resources and to couple that with an FTP server to publish files for either corporate or anonymous users over the Internet.

The trend, however, may be for Internet gateway vendors to start adding other Internet services to their basic product line. Firefox, for example, is

readying a POP3 mail server add-on that should be available by the time you read this. Called Nov*ix Mail Server, it will let you store your Internet mail on the same system as the Nov*ix gateway. Without it, normally you would either have your Internet provider set up your mailboxes and then have users access mail over your Internet link, or you would set up a separate mail server on another system on your network.

If this trend continues, one important question may be, which platform vendors will adopt to provide these integrated services. Although most Internet servers will probably continue to run on Unix boxes, Windows NT and NetWare may soon become more attractive options. Internet Junction, for example, chose Windows NT as the *gateway* platform for the IJ Passport, in large part because of its ability to function simultaneously as an *Internet server*. Between those server products and these gateways, you can find a solution that's precisely what you need.—JG

Internet provide no logging statistics.

These features offer some practical benefits too. You may, for example, use activity logs to help diagnose traffic patterns or to optimize network performance. It may not be enough just to look through activity logs; you might want proactive management. For example, you may want to limit Web access to your managers while giving everyone else only e-mail privileges. IWare is the only product here that lets you do this.

Or you may want to specify that certain sites on the Internet are off-limits: Nov*ix lets you control access to specific domain names and IP addresses.

THE FINAL ANALYSIS

There's plenty of variation in this product mix. Small businesses that don't need security or management will prefer a clean,

plug-and-play solution like Instant Internet, while larger sites may pay more for the added features of a package like Nov*ix.

Internet Junction Inc.

IJ Passport

BY RUSSELL IWANCHUK
AND JOHN GARRIS

The initial release of IJ Passport is certainly easy to install and easy to use. But this software-only package includes no client applications or management tools, and its documentation is inadequate.

Unlike the other products here, IJ Passport runs on either a Microsoft Windows 3.1 or Windows NT 3.5 system (Windows NT is recommended once you

exceed 20 users). You'll need to factor in the price of a Windows-class system to the overall cost of this solution. (We also recommend separate systems for the NLM solutions here—IWare Connect and Nov*ix for Internet.)

We tested IJ Passport with Windows NT Workstation running on a 486/33 system with 16MB of RAM as our gateway. Internet Junction chose Windows NT over NetWare as its gateway platform because of Windows NT's flexible architecture: You can run other Internet server-based applications, such as FTP or Web servers, on the same box. IJ Passport, however, doesn't ship with any of these functions in the package.

Installation was quick and mostly painless. We started by configuring both the TCP/IP and the NWLink IPX software,

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CIRCLE 864 ON READER SERVICE CARD

Three Ways to Connect to the Internet

You've got choices for connecting your users to the Internet. Here are three approaches, with a few recommendations and warnings about each.

Individual dial-up accounts

Each user has a modem and a separate Internet account, through either a service provider or an on-line service such as America Online.

Advantages

- Inexpensive for a small group—no need for a router link
- Easy to configure and maintain

Disadvantages

- Slow; traffic is not routed over the LAN
- Not cost-effective for more than five to ten users
- No upgrade path for higher performance

Internet gateway

Each user runs Winsock-compatible applications over NetWare client software. A single gateway converts IPX packets into TCP/IP Internet packets.

Advantages

- Easy to configure and manage. Single TCP/IP stack on server minimizes configuration time and centralizes management
- Scalable to more than 50 users per gateway

Disadvantages

- Most implementations are limited to Windows
- Better for providing client Internet access than for configuring server applications
- Gateway can become a performance bottleneck if TCP/IP traffic is heavy

TCP/IP software on each client

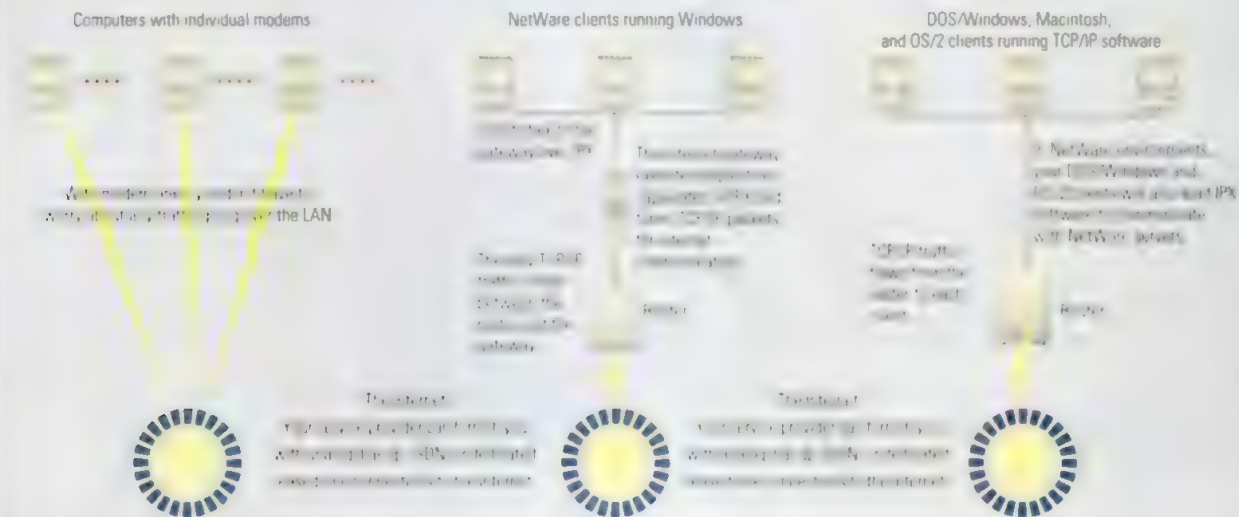
Each user's system has commercial TCP/IP software loaded, and the network is directly connected to the Internet using a router.

Advantages

- Multiplatform; products exist for all major operating systems
- Best option for sites with lots of TCP/IP traffic
- Can handle both client and server applications easily

Disadvantages

- Harder to configure and manage; you must deal with two protocol stacks at client and multiple IP addresses



which comes with Windows NT. If you use a Windows machine instead, you'll need to purchase a TCP/IP stack separately and download the IPX software from Novell's NetWare or CompuServe. After we loaded our protocols, we loaded the IJ Passport server software (a single executable file). On each of our clients, we then loaded Internet Junction's Winsock DLL. Finally, we had to add lines manually into each client's SYSTEM.INI file. Some automation here would have been nice.

It's also a good idea to know some things about TCP/IP, Windows NT, and NetWare before you attempt to install this product. The documentation, an eight-page set of release notes, left out certain installation steps that might be helpful to know more explicitly—such as the fact that

you need to reboot the server after making changes to the network and that you should specify the path to the Winsock DLL on the client. On the other hand, the docs do include helpful checks at every step in the installation.

Although this version came with no client applications, the company is negotiating to add an application suite in the near future. We tested with WinQVT shareware software; its e-mail, FTP, newsreader, and telnet functions all worked successfully. Getting Netscape 1.1 to work required some undocumented client configuration changes, but after that it ran fine.

IJ Passport provides no management tools either. The log file only shows when client connections are opened and closed, and you cannot block Internet access ei-

ther by user or by application. Internet Junction says its HTTP-based management tools package will be out sometime this summer. Technical support consists of 30 days of free fax, e-mail, and phone assistance.

Although IJ Passport provides good gateway functionality for your IPX clients, and it was the least expensive package we tested (the ten-user version is only \$110 per user), the lack of client applications and management tools make it a less-than-complete solution.

IJ Passport. List price: For 5 users, \$595; for 10 users, \$1,095; for 25 users, \$2,595; for 50 users, \$4,995. Internet Junction Inc., Mountain View, CA; 415-934-3600; fax, 415-934-3601; Web, <http://www.ij.com>.

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CIRCLE 894 ON READER SERVICE CARD

Performance Technology Inc.

Instant Internet

By JOHN GARRIS

As ambitious as the name sounds, Instant Internet lives up to its billing. This is a hassle-free, all-in-one solution that's an excellent choice for smaller NetWare sites. Unlike the other products here, it comes in its own standalone box, so you don't even have to think about involving one of your live servers.

Along with a built-in LAN connection (we used 10Base-T, but BNC and others are available), it also comes with an internal U.S. Robotics Sportster V.34 modem, so you can connect to the Internet over a dial-up line. You don't have to do any configuring on any of your servers: You just plug in the power cord, the LAN cable, and the modem line, then run a simple

Windows configuration utility.

Configuration was surprisingly easy; you don't need to be an experienced system administrator. The setup program asks you a few straightforward questions, and the manual clearly indicates everything you should ask your Internet provider before you set up.

Instant Internet also provides a number of scripts to let you connect to more than 100 Internet service providers via an inexpensive, single-user SLIP or PPP account. Using these scripts you just enter the phone number, a user name, and password, and you're up and running. This account can then be accessed by all the users on your LAN simultaneously.

On the client side, Instant Internet is bundled with the WinWeb 1.0 browser (which has FTP capabilities), WinVN 0.93 newsreader, and Eudora 1.4.4 e-mail

client. Although WinWeb is a perfectly suitable Web browser, we prefer Netscape 1.1, which also ran flawlessly with Instant Internet.

We did, however, note one problem when we analyzed network traffic while using WinVN. From the moment we attached to our News server we saw that a small but steady stream of IPX packets was going from our client to the gateway and back, even when there was no TCP/IP data to transmit. A product manager at Performance Technology confirmed our finding and attributed it to the way that the newsreader application is written.

To get out to the Internet, you've got choices. You don't have to use the modem. Instead, you can configure Instant Internet to use a router connected to a higher-speed link to your Internet provider. It's a simple choice in the setup program.

Plugging In to Winsock

By Robert P. Lipschutz

Internet users want powerful and intuitive applications for accessing files, sending e-mail, and browsing the Web. Unfortunately, good applications have been the exception rather than the rule. The Windows Sockets API (Winsock), however, helps solve compatibility problems and reduces development times. The new version should set off a landslide of quality Windows-based Internet tools.

The Windows Sockets API Version 1.1 (Version 2.0 will be released soon) provides a layer between Internet applications and the underlying TCP/IP communications stack. Software vendors develop tools that talk directly to Winsock, and TCP/IP vendors develop Winsock interfaces for their stacks. The result is a structure that benefits both developers and end users. Developers need not worry about complying with a plethora of dissimilar TCP/IP stacks, while end users enjoy the wide variety of Internet applications that result from shorter development times.

Keep in mind that Winsock is only a specification; there are no guarantees that every "Winsock application" will work as advertised. Specifications do not ensure interoperability. Consequently, work continues on interoperability testing. Stardust Technologies (408-438-6643), cofounded by Martin Hall, one of the creators of Winsock, will provide a lab in which vendors can put their applications and stacks to the test.

As Winsock becomes more widely adopted, the face of the Internet applications market will improve dramatically. Today, most Internet tools come from one of two places—the Internet itself or TCP/IP vendors who bundle tools with their stacks. Most applications available on the Internet are quite good and are already Winsock-compliant.

But because you are paying little or no money for these applications, don't expect much help with installation or use. Many Internet aficionados pride themselves on getting applications to work without assistance, but corporations are different. Administrators must decide whether or not they can

live with shareware or free applications. Netscape, for one, is just beginning to offer low-cost support for its Internet tools.

Much of corporate America still prefers to buy packaged applications. Companies such as Frontier, FTP, NetManage, and Wollongong offer their own suites of tools bundled with a TCP/IP stack for around \$300 to \$500 per seat—a pricey proposition. They've been able to demand these prices because it's been one of the few ways to get a Windows 3.1 TCP/IP stack. Even if you're willing to pay the high prices, these applications may be written directly to the vendor's own TCP/IP stack and thus will not work with Winsock. This is fine if you're using the included stack but unacceptable if you plan to use a separate TCP/IP stack such as those bundled with the IP/IPX Internet gateways reviewed here.

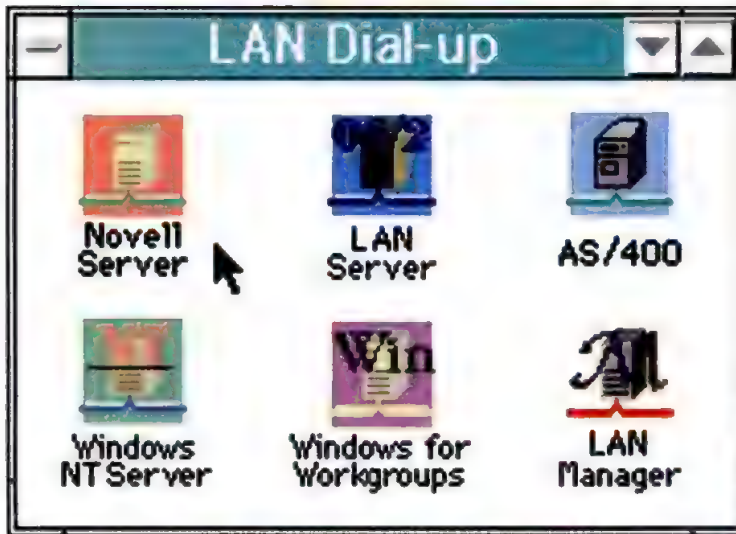
New OSs such as Microsoft Windows 95, Windows NT, and OS/2 Warp Connect will also include TCP/IP stacks, although they may not bundle a suite of quality access tools. (Warp Connect will contain several GUI Internet applications, but Microsoft's products offer only low-end DOS-based tools.) Some TCP/IP vendors will continue to sell their own optimized stacks for these OSs, but most people will use the included stacks for simplicity and convenience. Vendors will need to produce Winsock-compliant tools or they'll fall by the wayside.

Winsock provides the path to what most PC users have come to expect: best-of-breed applications. Application developers are forced to make Winsock-compliant tools available on-line, while TCP/IP vendors must uncouple their tools from their protocol stacks.

We expect each TCP/IP company to begin to offer a bundled Internet application suite that includes an e-mail client, FTP, Web browser, and more for under \$100. (Stay tuned.) This is the only way they will survive in the competitive world of the Internet. The combination of lower prices and better applications has fueled the PC software market for a decade and will catapult the Internet market even further into general acceptance. □

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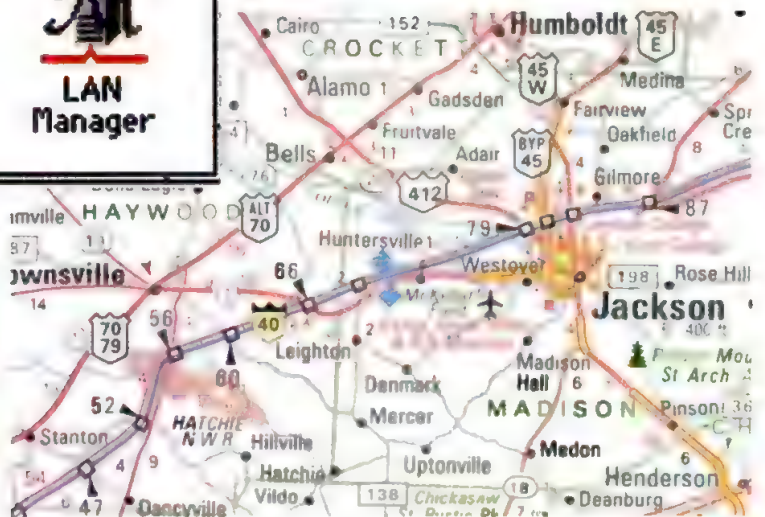
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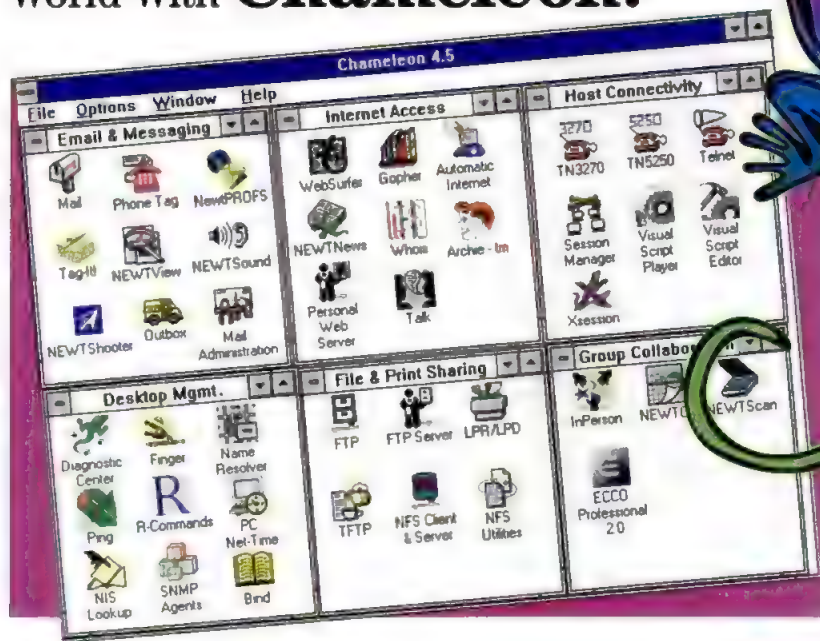


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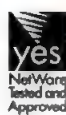
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World Wide Web: www.netmanage.com

In practice, you'll probably find a single modem connection too slow once you get beyond 5 to 10 users, especially if they use a lot of Web connections with heavy graphics. The modem solution is more appropriate for LANs with light Internet needs, such as e-mail or anonymous FTP file transfers.

There isn't much management capability in this first release. Basically, anyone who has the Instant Internet client DLL can run any applications and go to any site. Instant Internet does no checking or filtering. It also lacks a log file for tracking client usage. More comprehensive management features are planned for the next release.

Instant Internet works with Performance Technology's own PowerLan networks in addition to NetWare 3.x or 4.x LANs. All in all, if your Internet needs are simple and you want an easy solution to get you going quickly, Instant Internet is a winner.

Instant Internet. List price: License for 50 concurrent open applications, \$3,495. Performance Technology Inc., San Antonio TX; 800-784-4638, 210-979-2000; fax, 210-979-2002; Web, <http://www.perftech.com>. Circle 954 on reader service card

Internetwork Inc.

IWare Connect

BY RUSSELL IWANCHUK
AND JOHN GARRIS

Looking for an easy, affordable way to get your users on the Internet? IWare Connect could be the solution you're after—but with this package, you're on your own for basic Internet applications. Otherwise, it features powerful, straightforward administration tools and a simple installation. Remember, too, that as with the other NLM solution, Nov*ix for Internet, we recommend that you set up your IWare Connect server on a system other than one of your file servers. This means you'll need to supply such a system or factor in the cost of a new one.

Like Nov*ix, IWare installs as a set of NLMs on a NetWare 3.x or 4.x server. First you configure NetWare's built-in TCP/IP software, then you load the NLM over that. IWare also comes with a Winsock DLL that you load on all the client PCs that will have Internet access.

Installation was fairly simple, but some prior experience with TCP/IP and NetWare will make installing NetWare's TCP/IP stack easier. After installing the stack, it took us less than 10 minutes to get IWare up and running on the server and

SUMMARY OF FEATURES

IP/IPX Internet Gateways

PC MAGAZINE
NETWORK EDITION
EDITORS' CHOICE

■ YES ■ NO

Products listed in alphabetical order

	IJ Passport	Instant Internet	IWare Connect	Nov*ix for Internet 2.21
List price	\$4,995 (50 users)	\$3,495 (50 sessions)	\$4,995 (50 users)	\$8,750 (50 users)
Architecture	Windows 3.1 or Windows NT	Standalone box	NetWare NLM	NetWare NLM
Works with NetWare 3.x and 4.x server environments	■	■	■	■
Works with Windows 3.1 clients	■	■	■	■
Can create IP address pools	■	■	■	■
Application Support				
Compliant with Winsock 1.1	■	■	■	■
Bundled applications				
E-mail reader	■	■	■	■
FTP	■	■	■	■
Gopher client	■	■	■	■
Newsreader	■	■	■	■
Telnet client	■	■	■	■
Web browser	■	■	■	■
Security and Management				
Can restrict user access	■	■	■	■
Can restrict application access	■	■	■	■
Can restrict domain access	■	■	■	■
Reports activity to a separate log file	■	■	■	■
Lists names of all sites visited by clients	■	■	■	■

clients. The documentation, however, doesn't adequately explain fundamental TCP/IP concepts, so unless you're an experienced administrator you may be left with questions. For example, for configuring the server TCP/IP stack, the docs don't mention whether the default gateway you should use is your local router or the Internet service provider's gateway.

IWare does not currently ship with end-user applications. Furthermore, the first time we ran the Netscape 1.1 Web browser it gave us a network error. To run this version of Netscape successfully, we had to get a patch (which will ship with future releases) from Internetwork. We had no problems when we tested with earlier versions of Netscape or with WinQVT, a popular shareware application that provides e-mail, FTP, newsreader, and telnet functions.

We think that providing customers with a basic set of Internet applications is important, especially to help ease licensing and support concerns. Internetwork is working to bundle applications with future releases, and an announcement should be made by the time you read this.

IWare's management tools are intuitive, easy to use, and full-featured. IWare gets its user and group lists from the NetWare Bindery, and you can filter Internet usage by user name or group, time of day, or ap-

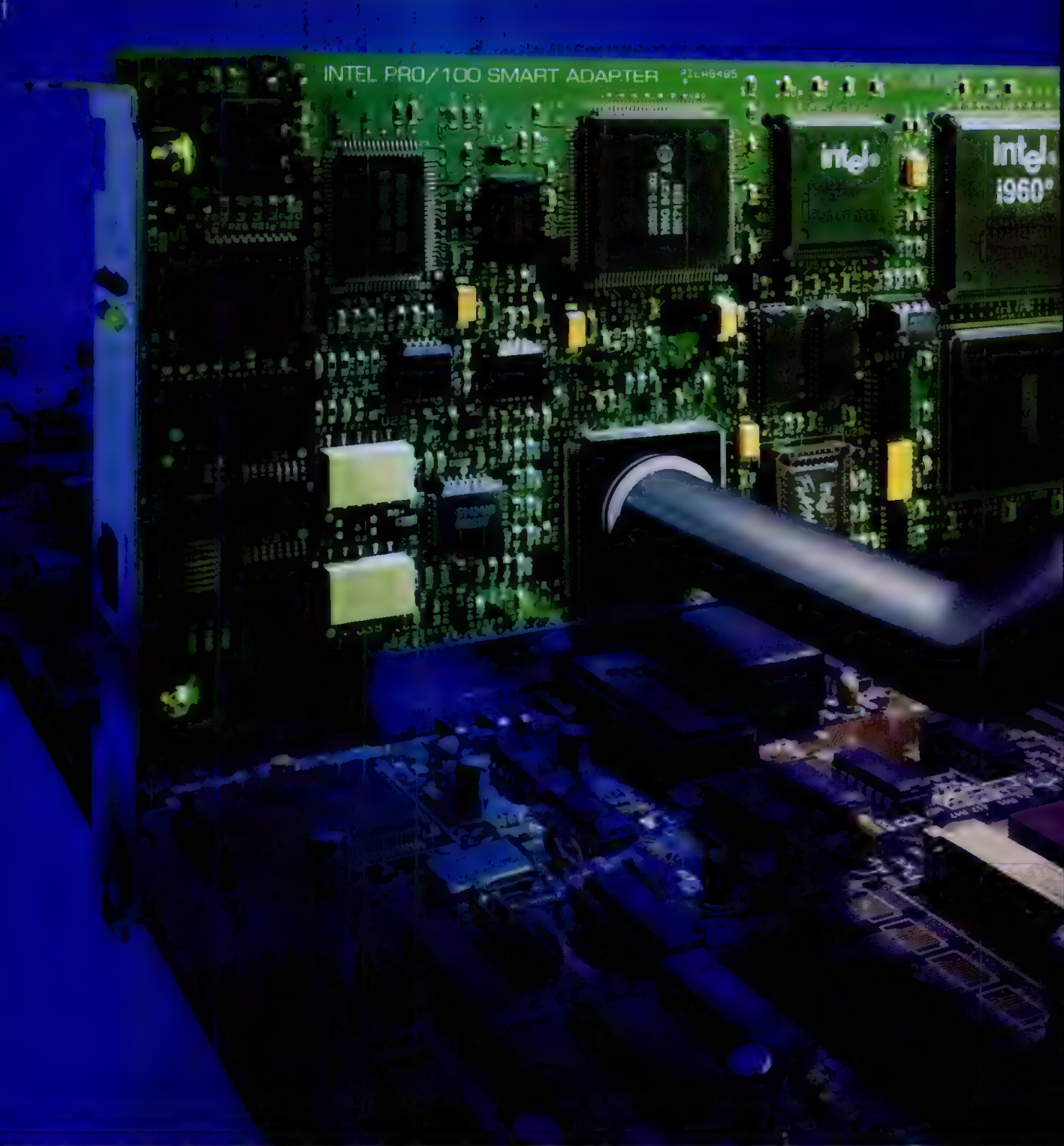
plication. All incoming Internet requests are ignored by default, so IWare won't compromise security by letting a user set up an FTP server. IWare also features an activity log that you can filter by NetWare user, group, or application. In addition, the log shows domain names of all the Internet resources your users access.

We did find a bug in IWare's security mechanisms. The software has a check-box option to allow only logged on users Internet access, but in our single-server environment we were able to have any server-attached client get on the Internet, even without a NetWare login. Internetwork says this will be fixed by the next release.

We tested a 10-concurrent-user version of IWare, which lists for a reasonable \$1,495. Free technical support is available for 30 days by phone and for unlimited time by e-mail. Overall, IWare Connect is a good solution for a simple, easily administered TCP/IP connection. If you want a complete solution, including application support, you should wait for the next release.

IWare Connect. List price: For 5 users, \$995; for 10 users, \$1,495; for 25 users, \$2,995; for 50 users, \$4,995; for 100 users, \$8,995. Internetwork Inc.; Sunnyvale, CA; 408-244-6141; fax, 408-749-8173; Web, <http://www.internetwork.com>.

Circle 955 on reader service card



© 1995 Intel Corporation. *Average throughput/CPU utilization with 5 nodes.

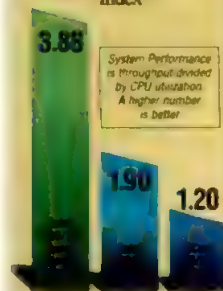
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Performance/Efficiency
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*SOURCE: LANQuest Labs, April 1995

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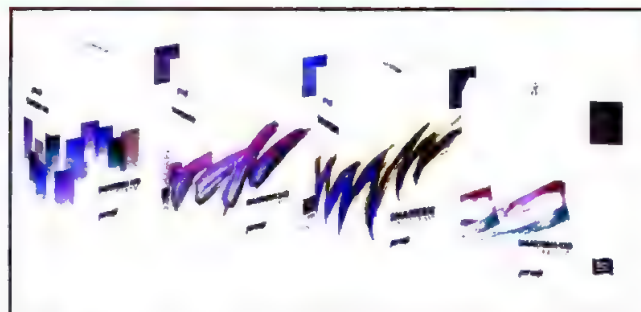


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CIRCLE 853 ON READER SERVICE CARD

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CONNECTIVITY SOLUTIONS
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Firefox Inc.

Nov*ix for Internet

BY JOHN GARRIS



The veteran here, Nov*ix for Internet is also the most complete package. Although it's priced higher than the others reviewed, Nov*ix offers good value, with its solid management tools plus a commendable suite of end-user Internet applications. Our only caveat is that you should set Nov*ix up on a system other than one of your standing file servers. This also means, of course, that you must factor the cost of such a system into your decision.

We installed and configured Nov*ix without much difficulty, although the product requires more NetWare and TCP/IP expertise than, for example, Instant Internet. Nov*ix installs as a set of NLMs on a NetWare 3.x or 4.x server. After loading the NLMs, you configure Nov*ix using the provided Windows configuration utility. It's a front end to a single .INI file that contains all required TCP/IP and NetWare parameters. Some options, such as security, can be changed only by manually editing the configuration file.

Once we were set up, we ran all of the

Nov*ix client applications with no problem. This package includes all of the applications most of your users will ever use: You get the Mosaic Web browser; the WinVN newsreader; and e-mail, FTP, Gopher, and telnet clients. In addition, you can load other Winsock-compliant apps to complement the list. We tested Nov*ix with Netscape 1.1 and it worked flawlessly.

Nov*ix boasts a full suite of diagnostic tools. You can PING remote hosts, view all current TCP or SPX connections, list security tables, or change logging and tracing options. You can execute these commands from the NetWare server or from a client.

Security is another strong point. You can block access to Internet sites based on IP address or domain name in one of two ways: Bar access to any site except those you specify or grant access to any site except ones you specifically filter. In either case, you use NetWare groups to get access to the sites you specify. There is however, room for improvement: We weren't able to give one NetWare group access to one set of sites and another group access to a different set of sites. We had other problems (which we eventually solved) getting Nov*ix to filter both domain names and their corresponding IP addresses properly. Unlike IWare Connect, however, Nov*ix cannot filter on application type.

For TCP/IP communications, Nov*ix uses a proprietary TCP/IP stack instead of NetWare's standard stack. The Nov*ix TCP/IP stack is multihomed, so it can service multiple IP addresses to let you create IP address pools. Although most people with basic Internet needs will use a single IP address on the gateway, you may need to configure individual IP addresses or address pools if you have more sophisticated TCP/IP environments or if you want to create Web or FTP servers on your network. Nov*ix is the only product reviewed that offers this feature.

For all of these features, you do pay more. But Firefox does offer other products to suit individual needs: Nov*ix for Client/Server includes the Nov*ix server engine without any Internet applications, and Nov*ix for Workgroups bundles Novell's LAN Workplace client applications. Overall, Nov*ix for Internet is a sophisticated package that's an excellent choice for NetWare environments.

Nov*ix for Internet, Version 2.21. List price: For 5 users, \$1,575; for 10 users \$2,725; for 25 users, \$5,275; for 50 users, \$8,750; for 100 users, \$14,850. Firefox Inc., San Jose, CA: 800-230-6090, 408-321-8344; fax, 408-321-8311; Web, <http://www.firefox.com>.

Circle 956 on reader service card

GLOSSARY

Internet Alphabet Soup

FTP File Transfer Protocol, the protocol that defines the transfer of files between a host and a remote station on an IP-based network. Also, a program based on this protocol

Gopher A simple TCP/IP tool that allows you to organize and display information within a hierarchical menu system

Internet server A computer that offers applications and information to Internet users. Examples include FTP servers, Gopher servers, News servers, and Web servers

IP Internet Protocol; the portion of the TCP/IP standard that routes messages from one Internet node to another

IP/IPX Internet Gateway A software or hardware package that translates IP packets into IPX packets and vice versa. It allows a NetWare LAN to access the Internet

IPX Internet Packet Exchange; the communications protocol for NetWare that routes messages

from one node to another

ISP Internet Service Provider; a commercial company that offers individual access to the Internet

Leased Line A telephone line rented for dedicated access to the Internet

PING Packet Internet Groper; a tool that sends packets of information to a computer on a network. It can determine whether a given Internet address is on-line

Network News Transfer Protocol (News, or NNTP) A TCP/IP protocol that defines how newsgroup messages are posted and transported between services

SLIP/PPP Serial Line IP/Point-to-Point Protocol, a pair of protocols, each of which allows a machine to connect to the Internet via a standard phone line and a high-speed modem. Most Internet packages support both, but PPP is the more advanced standard

SPX Sequential Packet Exchange; a communications protocol that operates on top of IPX and ensures that an entire message arrives intact

TCP/IP Transmission Control Protocol/Internet Protocol, a collection of communication protocols that allow dissimilar PCs to speak to one another over a common network (the Internet). It was originally developed by the U.S. Department of Defense in the 1970s

Telnet A terminal emulation protocol that allows an Internet user to log on to other stations remotely; also, a program based on this protocol

Winsock Windows Sockets; an API that serves as a common interface between a Windows client application and the TCP/IP protocol

World-Wide Web (the Web, or WWW) A segment of the Internet—developed by CERN—which lets users access multimedia documents connected via hypertext links. All documents are authored using HTML

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

NETWORK BACKUP

(Even Better) Backup from Palindrome

By John Garriss

In a market where we finally see consistently reliable packages from several companies, some products still rise above the rest. Quality backup software takes pains to make sure that all of your backup-related tasks are handled quickly and easily.

That's why we like Backup Director 4.0. Designed for NetWare 3.x and 4.x networks, this new version adds many features to its 3.1 predecessor (Version 2.1 was the Editors' Choice in our roundup last year, "Performing Backup Magic," March 29, 1994). It's also very competitively priced.

Among the new features are a new Microsoft Windows client interface, native NetWare 4.1 NetWare Directory Service (NDS) support, superior file-tracking and tape-rotation capabilities, and good alerting and reporting mechanisms. In addition, Version 4.0 is compatible with Novell's Storage Management System (SMS). All in all, this is a great new product designed to meet all your serious backup needs.

WINDOWS WELCOME

Thanks to the Windows interface, even the bold new features set doesn't make the program harder to use. Launching Backup Director takes you to the Central Console, consisting mostly of Windows 95-like tabs and big buttons that let you select all the different backup-related functions you'll perform.

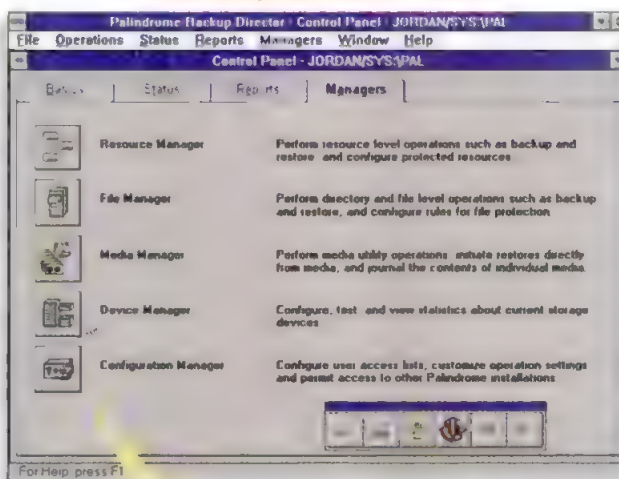
Backup Director also has *Cue Cards*, which help new users get started. When you press "Back-up," dialog boxes take you

through all the steps necessary to perform your first backup job. These Cue Cards are really interactive help engines, and they do a great job of immersing you in the guts of the program.

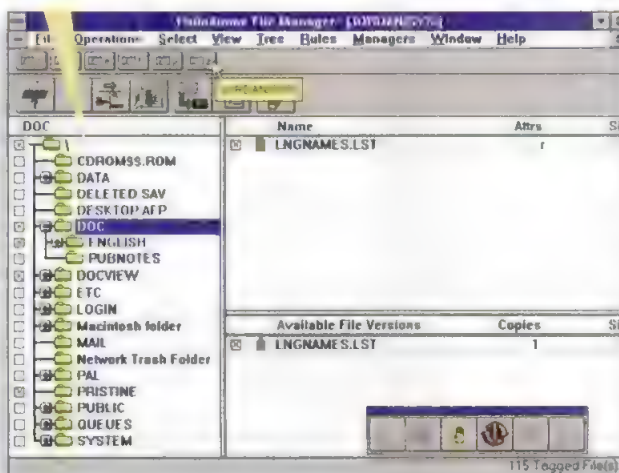
The Central Console acts as

a launch pad for a set of five programs called *Managers*, which handle all your backup chores. For example, you run the Resource Manager to back up or restore NetWare volumes or client drives; you run the

Backup Director 4.0



LOOKING GOOD: Backup Director's welcome new Windows interface includes an intuitive, button-driven Central Console and a convenient File Manager.



Media Manager to browse through backup tape sets.

EASY GETTING STARTED

Installation was fairly straightforward and took about an hour. First you run a setup program at the server, which checks out your server environment and installs updated versions of common NetWare files if needed. Then, from a Windows client, you install all the main server and client files. The NetWare server processes all backup jobs and services the job queue, while you submit backup and restore jobs from the client.

NetWare 4.1 administrators will appreciate Backup Director's support for native NDS. Most other packages (including Cheyenne's ARCserve and Legato NetWorker) require a Bindery-emulation login at each server. The Palindrome documentation also does a great job of addressing NetWare 4.1-specific issues, such as NDS database backup and Admin user privileges.

YOUR DATA IS SAFE

To run some performance tests with Backup Director, we set up a NetWare 4.1 server on a Compaq Systempro XL 486/33 with 32MB of RAM. Our Windows management client was a Compaq Deskpro 486/33 with 16MB of RAM. We used an HP SureStore 6000 DAT drive for all our tape backups.

We ran a series of both single-server and multiple-system backups with no serious problems. Our 770MB full-server backup, which consisted of a mix of text, graphics, database, and executable files, took about 28 minutes (27MB per minute). When we added two DOS client systems, the

Continues on page NE29

FILE TRANSFER VIA FAX

Is That My File or Is It Art?

By Steve Buehler

If you spend lots of time and money faxing documents to remote offices, you're probably looking for a way to reduce your out-of-pocket telephony costs. InfoImaging Technologies' new 3DFAX (\$199 for the Professional edition) may be just the thing you need—but we stress the word *may*.

3DFAX lets you transfer files using standard fax protocols. In other words, you can send a file from one fax modem-equipped PC to another—or even to a fax machine. Because 3DFAX first compresses user-selected files into a proprietary format, or InfoImage, the product can transfer files in a fraction of the time normally required to send a fax. By using standard fax protocols, which are recognized around the world, it minimizes time spent configuring communications devices for transfers. Also, it lets you encrypt and password-protect each file for security.

While this unique product is technically intriguing, it will not fit well into many environments. You may find that you can do file transfers in less time with standard comm software—even PKZIP in conjunction with Windows' Terminal. If, however, you do a lot of faxing to remote or client sites that already have PCs set up as fax servers, 3DFAX may be the easiest way to cut your fax telephone bills by half.

HOW IT WORKS

There are two ways to use 3DFAX, and each has different hardware and software requirements. In the first scenario, this product needs a PC with a fax modem and a fax package, such as Delrina's WinFax PRO, on each side of the connection. If you already have this setup, 3DFAX may make sense for your environment. There's no need to hassle with configuring

a standard comm package like Datastorm's Procomm Plus. Additionally, 3DFAX provides good file compression and low telephone usage, which will save you money. Finally, as many people leave their fax applications running all day, incoming InfoImages can be received automatically just like other faxes.

The second way to use 3DFAX is to send the InfoImage directly to a fax machine. The resulting printout looks vaguely like a Magic Eye poster. Scan that unreadable InfoImage into 3DFAX at the recipient PC, and you can expand it back into the original file. This requires a PC with a fax modem and fax software on one end, and a fax machine and a PC with a scanner on the other. Here again, if you already have this hardware and software setup, 3DFAX might make sense as an inexpensive way to save on fax or file-trans-

fer telephone costs.

We tested both methods and got mixed results. Compared with a standard fax machine, 3DFAX has a clear advantage. While it took us approximately 22 minutes of connect time to send a 45K Microsoft Word 6.0 file to a fax machine (as a standard fax), the same document took only about 9 minutes to transmit over the phone lines as an InfoImage.

Against comm software transfers, however, 3DFAX does not compare quite as well: Using Procomm Plus, we transferred the same 45K file in only 4 minutes of active phone time. In fact, extensive testing with our standard suite of modem test files showed that 3DFAX's performance consistently lagged behind that of Procomm Plus.

3DFAX comes in three versions. The freeware version, available from InfoImaging's World-Wide Web site or via phone request (\$6.95 for shipping and handling), can read InfoImage files but can only send files that fit on four or fewer fax pages. The Standard

version (\$99) can read InfoImage files but doesn't support password protection and can't send executable files as InfoImages. The Professional version (\$199) can send and receive all InfoImage files and adds password protection.

One final warning: Unlike almost every current fax or comm software package we've seen, 3DFAX Professional uses a copy-protection scheme that requires a set of hidden files and a "token" that must be transferred from floppy disk to hard disk. Beyond a cryptic message in the documentation not to remove any 3DFAX files, no warning is given that the user must invoke an undocumented batch file to move this token when moving the software to another machine. Simple carelessness—or worse, a virus—could undercut 3DFAX's usefulness in a hurry. **3DFAX.** List price: For Standard edition, \$99; for Professional edition, \$199. InfoImaging Technologies Inc., Palo Alto, CA; 415-960-0100; fax, 415-960-0200; Web, <http://www.infoimaging.com>.

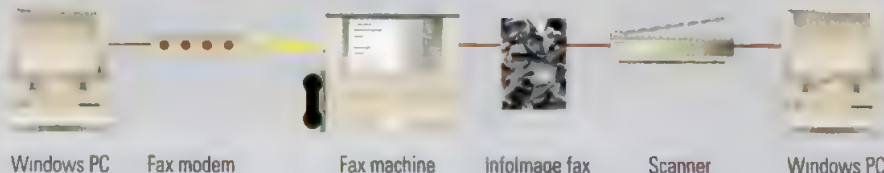
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The Two Modes of 3DFAX

With 3DFAX, you can transfer compressed, encrypted files directly between two fax modem-equipped PCs.



Or you can send a file from your PC to a standard fax machine. The file can then be retrieved by scanning the printed image, or InfoImage, into another PC.



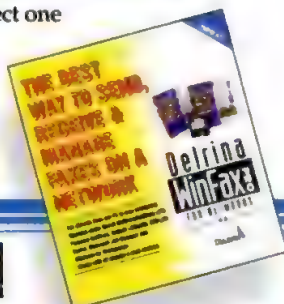


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New Delrina WinFax PRO for Networks 4.0

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CIRCLE 912 ON READER SERVICE CARD

John McBride
Available Mon 10-12
(MS Windows PC
on TCP/IP)

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Kate Devereaux
Available Mon 9-12
(Macintosh on
AppleTalk DECnet)

Dan Falken
Available Mon 9-12
(MS Windows PC
on PATHWORKS)

Tung Stella
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(DOS PC using VINES)

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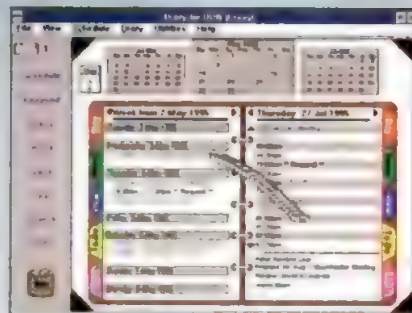
Calendar Manager can.

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RUSSELL Lauren Hills, CA
INFORMATION SCIENCES Hampton, NH
London, England

For more information
on Calendar Manager
call 714-362-4000
or fax 714-362-4040.

Palindrome

Continued from page NE25
resulting 1,120MB backup took 62 minutes (18MB per minute). In our testing, backup performance was right on par with similar packages. We did have some problems viewing job status while the backup was running: Occasionally the program seemed to hang, taking more than a minute to fetch job information from the server.

Palindrome uses Target Service Agents (TSAs) to back up NetWare servers and DOS, OS/2, and Windows clients (a Macintosh agent is in testing). TSAs are part of Novell's attempt to standardize NetWare backups with its SMS architecture. Palindrome also uses Novell's SMS-based System Independent Data Format (SIDF) to write to tapes, ensuring read/write interoperability with other packages.

If you have multiple tape drives, you can run multiple backups to your drives simultaneously. But Backup Director doesn't interleave multiple jobs onto one tape (unlike Legato NetWorker and Symantec's Norton Enterprise Backup).

LEAVE THE DRIVING TO...

Backup Director does a great job of managing your backup media. It keeps track of all your tapes and automatically prompts you to change tapes or move tape sets to or from off-site storage. Backup Director works with both the grandfather-father-son (GFS) and Tower of Hanoi tape-rotation schemes.

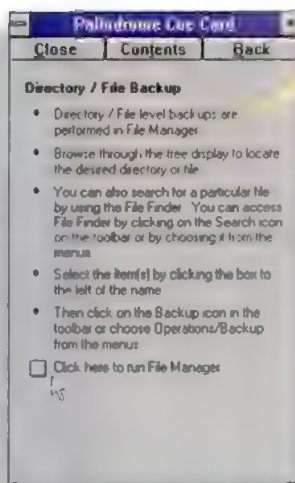
The reporting and alerting tools in Backup Director are also excellent. You can specify filters, by job number or by message type, when you view the detailed activity log. You can also have messages sent to you by NetWare broadcast, by MHS-based mail, or by standard SNMP alerts to management consoles such as Novell NMS or HP OpenView.

ONE FILE AT A TIME

You use Backup Director's File Manager program to back up or restore individual files or directories. It gives you an integrated list of all files either on tape or disk. You click on a file to see all the versions of the file automatically in either location. You can also use wildcards and scripts to tag the exact files you want.

Our only problem with the File Manager was that it was relatively slow. If you have intricate directory structures you may find yourself waiting a while to browse through the file system.

File Manager also lets individual users restore their own files—a big plus for network



administrators, who have better things to do with their time. Unlike ARCserve, Backup Di-

ON CUE: Backup Director's Cue Cards guide you through the backup process.

rector uses standard NetWare security to filter user access to individual files, so you can keep your private directories hidden from your users' reach. It's a very complete package.

Backup Director 4.0. List price: One server with up to 25 users, \$349; one server with unlimited users, \$995; multiple servers with unlimited users, \$1,595; auto-changer support, \$795 (single drive), \$1,995 (multiple drives). Palindrome Corp., Naperville, IL; 708-505-3300; fax, 708-505-7917.

Circle 974 on reader service card

WINDOWS/UNIX INTEGRATION

WinDD: In a Class by Itself

By O. Ryan Tabibian

Until now, the wealth of Microsoft Windows-based applications was available to Unix machines only by way of slow, often unreliable Windows emulators. With Textronix's new WinDD Server, however, you can give your Unix users the power to run Windows applications in native mode.

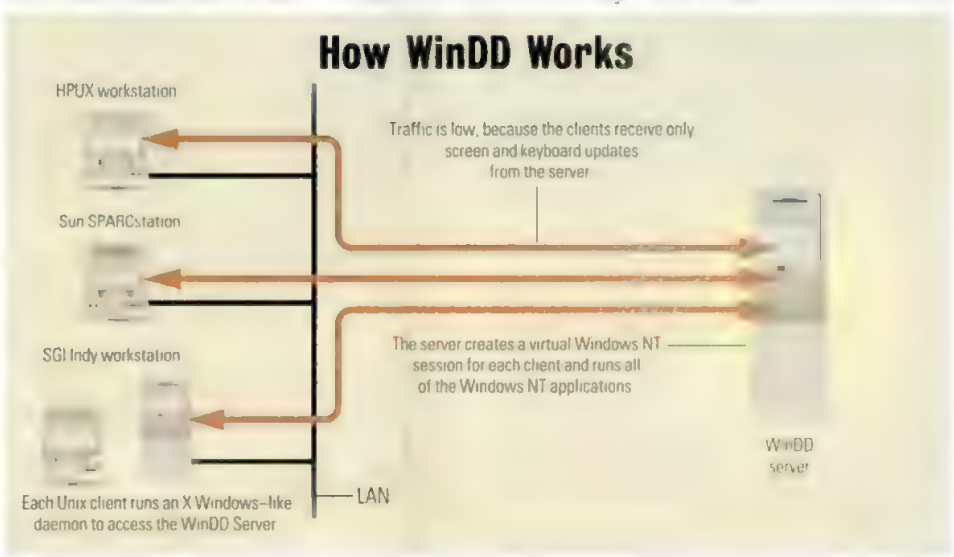
The core of WinDD is a Microsoft Windows NT server with some enhancements that

let you simultaneously run multiple sessions of Windows NT on Unix machines attached via a proprietary X Window implementation. Although this sounds complicated, it is very similar to a PC remote-control application, since the applications run on the server and the clients receive only screen redraws and keyboard refreshes.

Through WinDD, each Unix workstation attached to the Windows NT server can run any

16- or 32-bit Windows application that is Windows NT-compatible. Because these applications run in native mode on the server, WinDD eliminates the compatibility problems associated with Windows emulation packages, such as Insignia Solutions' SoftWindows and SunSoft's WABI. We found WinDD to be the simplest and best performing solution for running Windows applications on Unix workstations.

With WinDD, a Unix workstation can do almost anything a Windows NT PC can do. In fact, WinDD even has built-in





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NETWORK EDITION

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printing support to both Windows NT printers and LPR Unix printers on the network.

SoftWindows and WABI, on the other hand, can emulate only Intel 286 PCs running Windows 3.x on a variety of Unix platforms. By definition, emulation is not the original Windows code, so compatibility problems are common. Also, with WABI most applications have to be "certified" before they can function properly. By the time this takes place, the certified application is typically a full revision behind the most current version of that application.

Finally, most emulation packages run Windows in standard mode, which means that most of the popular Windows applications—which require Enhanced mode—are unus-

able. WinDD does not have many of these inherent problems, since it runs all applications natively on the Windows NT server.

With this in mind, we were anxious to see how WinDD would perform. We installed the WinDD Server on an HP NetServer 5/66 LF with 128MB of RAM. For clients, we used a Hewlett-Packard HP/UX and a Silicon Graphics Indy workstation. Each of these machines was connected to a shared 10-Mbps Ethernet network.

The server installation was very straightforward, and we were up and running in only a couple of hours. That may sound like a long time, but most of it was actually spent installing Windows NT on the server. The client installation and configuration was equally

simple. The only thing that was required was to install the WinDD, X Window-like daemon on each workstation and attach to an existing server in your network.

While WinDD performed well, we found that it needs some serious hardware to do so. There are two reasons for this: WinDD requires Windows NT, and (more importantly) the product emulates multiple PC's in a single box. For example, in order to run 15 concurrent sessions effectively, we found that we needed a server with at least a 66-MHz Pentium CPU and 64MB of RAM. Because of Windows NT's multiprocessing support, you may even want to add CPUs as your needs grow.

Despite the hefty server requirements, we saw that

WinDD imposes a very light burden on overall network bandwidth. With six active sessions, we saw through a Network General Sniffer that the peak load on the LAN was only 10 percent, with a sustained average of between 4 and 5 percent.

On the clients, we ran a wide range of applications and suites, including CorelDRAW 5.0, Microsoft Office, and even DOOM. They all ran smoothly, with the exception of DOOM (since Windows NT runs DOS applications in emulation mode, DOOM ran somewhat slower than it does normally).

WinDD Server. List price: For a 10-user license, \$3,495 plus \$195 per client. Texttronix Inc., Wilsonville, OR; 800-547-8949; fax, 503-682-4948.

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First Looks

INTERNET ACCESS TOOLS

One-Stop Shopping from IBM

By Cade Metz

Accessing the Internet can be a daunting task. First you have to decide on a connection type, then you have to get hold of the tools necessary to make that connection. But IBM's new Internet Connection for Windows, Version 3.0 (\$129), consolidates this process into a single, simple solution. This exhaustive suite of access tools, a modem, and a half hour are all you need to begin cruising the Net.

Internet Connection includes a World-Wide Web (WWW) browser and newsreader, along with FTP, Gopher, mail, and telnet clients. Also included are Viewer, which displays .GIF, .JPEG, and .BMP graphics files downloaded via WWW or Gopher; Setterm, which lets you customize telnet sessions; and TCPChk, which tests your network connection.

Internet Connection installs quickly and painlessly. After the software is loaded, a separate utility launches to step you through the process of setting up your Internet account. You can sign on with IBM's own service provider, Advantis, or with a provider of your choice (the software includes a list of several major providers from around the country). The Advantis server was down for several days when we began our testing, but it provides SLIP accounts quickly and easily when on-line.

With the SLIP account in hand, you're ready to start using Internet Connection's complete suite of GUI access tools. Each of these is launched from a compact toolbar on the right side of the main window.

IBM WebExplorer is an enhanced version of NCSA Mosaic. A standard cache of navigational buttons and an HTML-source-code viewer are welcome features. The browser's status bar, however, is less

than impressive: While loading a document, it displays only stock messages rather than the actual progress of the download. For a better status bar (and better performance), you can load another browser, such as Netscape Communications Corp.'s Netscape Navigator, and add it to the Internet Connection icon bar.

Though not quite as intuitive as SPRY's Network File Manager, IBM FTP provides an easy-to-use interface. You enter your user information and the name of the desired host and watch another terse status bar as the connection is made. Once you're connected, a second window opens displaying the remote site's directory tree. To transfer a file, you simply highlight its filename and select Transfer. For quick access, you can assign your

favorite sites to icons on a convenient vertical toolbar.

If you're into newsgroups, you'll appreciate IBM News-Reader's slick GUI as well. This is one of the best organized and easiest-to-use newsreaders available. The main screen is divided into three windows: a list of the newsgroups to which you have subscribed, a list of message headers from the currently selected newsgroup, and (in the largest window) the text of the selected message. Messages can be posted, sorted, and organized via menu buttons.

IBM Gopher is another strong tool, despite the fact that it displays an excessive number of cartoon-like gopher heads. Like Ameritech's WinGopher, IBM Gopher opens a new sub-window each time you access a new server. Different icons indicate different types of documents, while the aforementioned gopher heads indicate other Gopher sites.

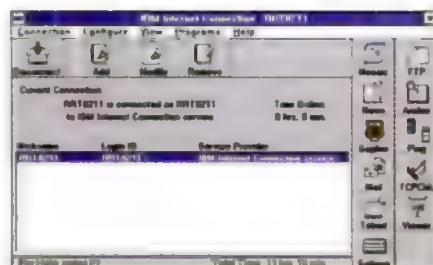
The rest of the suite is solid and unpretentious: IBM Mail organizes incoming and outgoing messages using a familiar folder metaphor. IBM Telnet supplies a GUI interface for opening a session on a foreign host. IBM Archie lets you search for information using nine servers. IBM Ping lets you test the time required to connect to a given host.

Most of the tools in Internet Connection for Windows are also available in IBM's Internet Connection for OS/2, which is bundled with OS/2 Warp and the forthcoming OS/2 Warp Connect. The former, like its Windows sibling, connects to the Internet via SLIP; the latter adds direct LAN access.

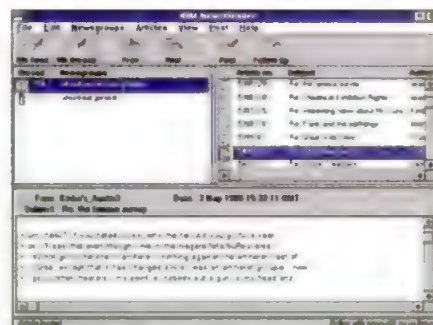
Internet Connection for Windows, Version 3.0. List price: \$129. IBM Corp. Networking Software, Research Triangle Park, NC; 800-342-6672; Web, <http://www.ibm.com>.

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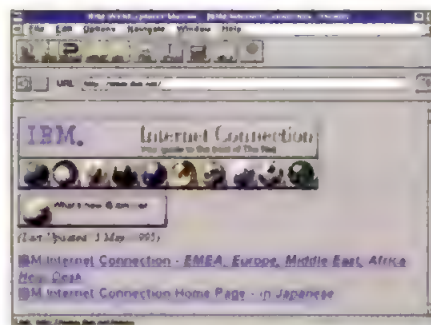
Internet Connection for Windows



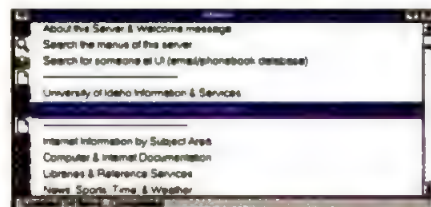
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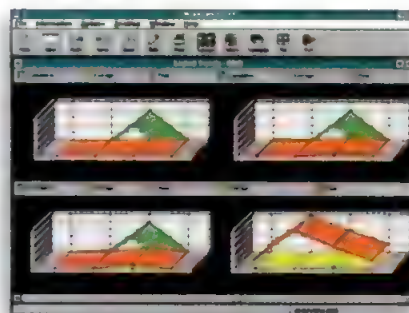
By Greg Alwang

Many NetWare administrators rely on limited information and a healthy dose of luck to keep their servers running efficiently. But armed with Avanti Technology's new NConsole, Version 2.0, administrators can unlock the secrets of NetWare servers and even uncover potential problems before they occur.

NConsole (\$295 to \$395 per server) is a powerful, Windows-based trend-analysis and baseline-sampling tool for NetWare 3.x and 4.x. The product includes an NLM along with Windows and DOS client utilities. Each of the components is

easy to install and even easier to use. NConsole should prove itself an invaluable addition to any NetWare administrator's toolbox.

The key to NConsole's usefulness is the data it puts at your fingertips. Using this data, you can be proactive—detecting potential problems and taking the steps necessary to avoid them—rather than reactive, wasting time putting out fires that should never have happened. For example, you can use NConsole to monitor such key elements on your server as CPU utilization or pending disk I/Os. By keeping an eye on these statistics with NConsole,



EASY READER: NConsole's colorful graphs simplify the art of server monitoring.

you'll know when these averages start to climb so that you can correct system problems or start thinking about upgrading the server.

PIECE BY PIECE

Although it requires a mere 53K of server memory, the NConsole NLM monitors over

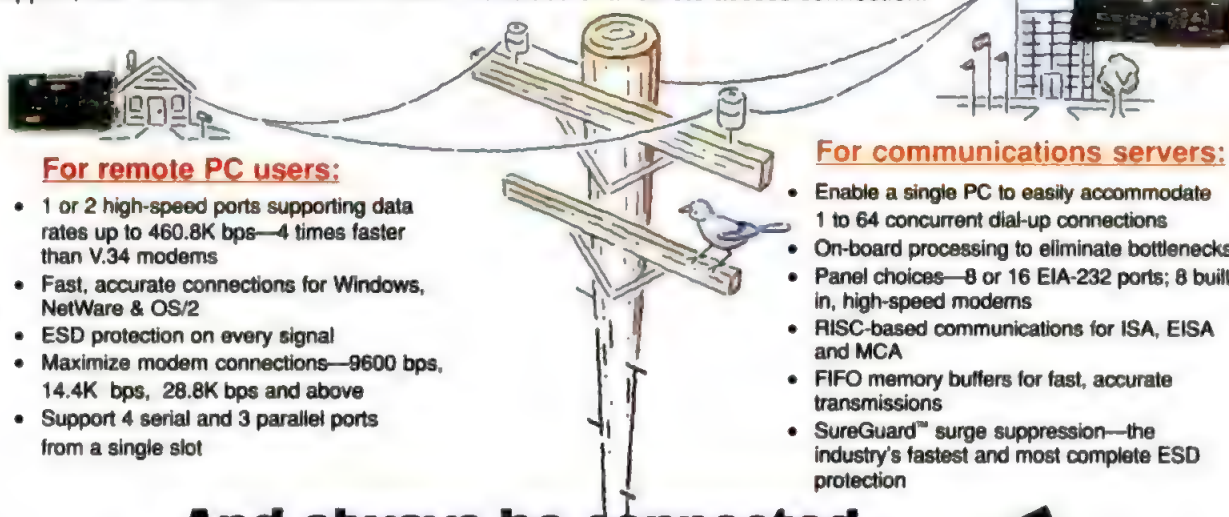
100 server statistics in real time. The NLM also saves the current, average, and peak values to a log file at specified intervals ranging from 1 minute to several days.

The NLM interface conveniently packs over 90 statistics on one screen. Anyone familiar with NetWare's

MONITOR.NLM will applaud this capability: No more searching through a multitude of menus to find a single server statistic. Also, a CPU utilization graph runs across the bottom of the NLM screen, illustrating the last 74 seconds of utilization. Finally, this NLM can act as a keyboard lockout

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First Looks

mechanism (requiring a password to activate the server console) and even as a screen saver.

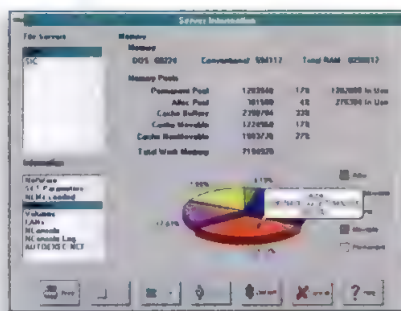
The most striking portion of NConsole is the Windows client module, which allows you to monitor real-time data and historical trends related to your server's statistics. Colorful graphs track everything from CPU utilization and the average number of open files per connection to server NIC transmit packets. Also, these graphs can be edited, printed, saved to disk, or copied to the Windows clipboard for use by other applications.

You pick the statistics you want to monitor by creating a graph window. NConsole offers three ways to access the statistical information: views, trends, and linked trends. View windows depict a real-time

graph of a selected statistic, while trend windows display a historical record of a given statistic over a user-specified period of time. Linked trend windows show the data from up to four trend graphs (with a common time period) in a single window.

NConsole comes with 22 predefined graph windows to help get you started viewing the over 100 statistics and trends available. When multiple graph windows are open, you can choose to tile or cascade them for easier viewing. More important, you can set specific windows to open automatically each time you launch NConsole.

In addition to statistics and trends, NConsole's Windows client provides access to information about the server's NLMs, memory, volumes, net-



PICK A SLICE, ANY SLICE: NConsole's graphs provide a wealth of server information.

work information, and those confounding NetWare SET parameters. NConsole even lets you change any of the SET parameters then automatically updates your STARTUP.NCF or AUTOEXEC.NCF files to include those changes.

The DOS client module, or NCREMOTE, lets you monitor your server statistics from a Net-

Ware client. In fact, the NCREMOTE display is an exact duplicate of the NConsole NLM screen. NCREMOTE is similar in function to the NetWare RCONSOLE utility, except that it demands fewer system resources.

The documentation and on-line help are thorough, with

detailed descriptions of each NetWare statistic tracked by NConsole—something you won't find easily in the NetWare manuals.

NConsole, Version 2.0. List price: Without SNMP agent, \$295 per server; with SNMP agent, \$395 per server. Avanti Technology, Austin, TX; 800-638-1168; fax, 512-335-7838.

THE NETWORKER By Diane Danielle

Readers Say Yes to Manuals



When I wrote my February 7 column, I expected lots of commiseration from all the people who don't read manuals. To my surprise, however, I received reams of mail reprimanding me for my cavalier attitude.

Rabbi Don Weber and Jay Herold (both of whom say they read every manual cover to cover), Don Gilman (who admits he doesn't read every manual cover to cover), and Eric Woodhouse (who insists he at least looks at every page and includes the entire set of NetWare 3.12 manuals in his list) all emphasized that reading manuals saves time and carries rewards: It's what makes their coworkers or clients consider them experts.

Dan Jinks and Greg Cronau were even more severe. Dan reminded me that if one's living is based on knowledge, not having that knowledge places one at a competitive disadvantage. Greg admitted that many manuals are "tedious, badly written, and at times boring, but who said any of this was going to be easy?" He wonders what somebody who can't be bothered to read a manual is doing in this profession.

For sheer manual-reading determination, however, the winners are Dick Minick and Peter O'Connell. Dick swears that he took the WinWord 2.0 manual on vacation, read it cover to cover, and took notes. He didn't have his laptop with him (it was in the shop), and his wife attributes his behavior to withdrawal.

Peter says he's read the four-volume Microsoft Visual Basic 3.0 and Microsoft Access docs, as well as eight of the ten Borland Pascal manuals (he's saving the alphabetic function reference for when he really needs it) and offers the following "Top Six Reasons" for his bizarre behavior:

"1. Software Bloat: That's right, there is an advantage to the huge size of the latest software. I have seen enough reminders to register the software, and since I can't use the PC while I'm installing, I have more than enough time to peruse a table of contents, read the good parts, read the rest, read *Ulysses* by Joyce... and then just double-click and my program is running (by the time I get back with my coffee).

"2. If you can extract one pearl of wisdom from a manual and pass it on to your colleagues—or your superiors—they will think you are omniscient. Besides, you might just learn something useful.

"3. Picking up a manual to read gets me away from the keyboard, as a result of which I do not suffer from a repetitive-strain injury.

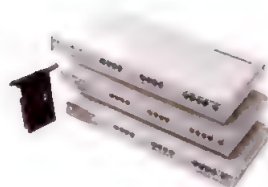
"4. Manuals represent the largest physical cost in software distribution. I want to make sure I get my money's worth.

"5. Many manuals are a sure cure for insomnia.

"6. I have always wanted my name emblazoned in print in a major computer magazine."

I thank all of you who sent me your lists of favorite manuals and promise that I have learned my lesson: Manuals *are* important.

Diane Danielle, an independent networking consultant, can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.



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NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Leslie Wygant

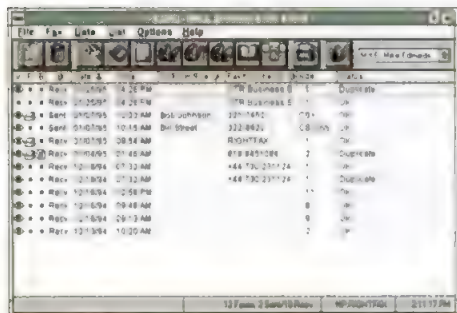
RightFAX Expands Faxing

If you're looking for a more flexible faxing package, one that works on multiple operating platforms, look at **RightFAX's** new offering—**RightFAX NT**. It's a true 32-bit Microsoft Windows NT Service-based fax server. **RightFAX** has also announced **RightFAX 4.0**, which dynamically imports user information from the NetWare 4.x NDS.

RightFAX NT. List price: For one line, unlimited users, \$1,995; for each additional line, \$1,295.

RightFAX 4.0. List price: For one line, unlimited users, \$995; for each additional line, \$795. **RightFAX**, Tucson, AZ; 520-327-1357; fax, 520-321-7456.

Circle 960 on reader service card



FAX IT TO ME: **RightFAX NT** lets you send and receive faxes from Windows NT PCs.

HP Offers Upgradable AdvanceStack Hub

Unmanaged hubs cost you less than hubs with management capabilities. But you're limited as far as upgrading to include management. **Hewlett-Packard Co.** has introduced the **AdvanceStack 10Base-T Hub-16U**, which is perfect for smaller networks that plan to add management later on. Although the Hub-16U does not include its own management capabilities, you can add an optional distributed management module to an SNMP **AdvanceStack** hub and then share management between **AdvanceStack** hubs.

AdvanceStack 10Base-T Hub-16U. List price: \$579. **Hewlett-Packard Co.**, Santa Clara, CA; 800-533-1333; fax, 800-333-1917; Web, <http://www.hp.com>.

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SCO OpenServer Release 5 Is Built to Run

Have you been looking for a better Unix application server? One that offers reliability, availability, serviceability, and scalability?

The Santa Cruz Operation (SCO) now offers **SCO OpenServer Release 5** (based on System 5 Release 3.2), to bring a new level of reliability for Intel platforms. **OpenServer 5**, which works with over 900 types of computers and 2,000 peripheral devices, is designed to protect business-critical applications, data, and hardware.

SCO added a graphical interface to Release 5 to simplify using and managing the system, so you don't need to worry about entering lengthy Unix commands. You can also expect less downtime, improved performance, increased scalability, and distributed administration and management. **SCO's** product family begins with the **Base Operating System**, which includes the **Enterprise** and **Host Server** systems and **Desktop** system. **SCO** also offers add-on products for **OpenServer 5**, such as **Windows Services**, **Distributed Services**, **Reliability**, **Availability**, and **Serviceability Services**, **Developer Services**, and **Expert Services**.

SCO OpenServer Release 5.

List price: Ranges from \$695 for 5-user host system to \$24,995 for 5,000-user license. **The Santa Cruz Operation Inc.**, Santa Cruz, CA; 800-726-8649, 408-425-7222; fax, 408-458-4227; e-mail, info@sco.com.

Circle 959 on reader service card

SoftArc and the Internet

Internet access involves using standard and proprietary protocols. **SoftArc** has announced an expanded Internet strategy for **FirstClass**, its enterprise communication software. **SoftArc's** strategy allows users to access the Internet using both standard protocols and **FirstClass's** proprietary protocols. In addition to its existing TCP/IP implementation, bidirectional mail transfer capability, and **UseNet** newsgroups, **SoftArc** plans to add native FTP, HTTP, POP3, and SMTP protocols to **FirstClass**.

SoftArc Inc., Markham, Ontario, Canada; 800-364-1923; 905-415-7000; fax, 905-415-7151; e-mail, sales@softarc.com.

Circle 962 on reader service card



IT'S OKAY TO TOUCH: **Retoura**, for remote access, is as easy to use as a fax machine.

Digi Retoura Routes Remote Users

Remote users, physically removed from the network, need extra attention. **Digi International** targeted those of you working away from the office when it designed the **Digi Retoura Touch Router**. The **Retoura IP/IPX** router offers remote users a keypad and an LCD interface to make accessing the main LAN as simple as possible. The **Retoura** also offers asynchronous and synchronous ports for modem, leased-line, and ISDN connections.

Digi Retoura Touch Router. List price: \$1,995 to \$1,395. **Digi International Inc.**, Eden Prairie, MN; 800-344-4273, 612-943-9020; fax, 612-943-5398; Web, <http://www.digibd.com>.

Circle 963 on reader service card

New & Improved

SilCom's Freespace Beams Two Together

You can implement wireless connections from within a building, connecting individual PCs. On a grander level, you can connect two entire buildings. **SilCom Manufacturing Technology** has introduced Freespace for building-to-building wireless connectivity for Ethernet and Token-Ring networks. Freespace (manufactured by Freebird Communications) uses its own SkyFiber technology to act as an invisible fiber cable to link two buildings together. In case there's any movement, it uses a wide, oval, vertical beam to adjust and keep everything connected. The beam is then received by a lens at the other end. Freespace also includes a UPS in case of power failure.

Freespace. List price: \$14,995. *SilCom Manufacturing Technology Inc., Union City, GA; 800-388-3807, 404-964-9293; fax, 404-964-9282; e-mail, silcom@flexnet.com.*

Circle 964 on reader service card

BRIEFS

HARDWARE

Digital Products has added Flash ROM to its NETPrint series of print servers and its JETXPrint 1000 internal board for HP printers. The Flash ROM enhancement allows you to upgrade up to 25 NetPrint servers. Depending on your needs, you can choose from one to four connection ports. The NetPrint 1000 (\$595 with two ports) and NetPrint 2000 (\$995 with four ports) work with NetWare IPX/SPX and AppleTalk, as well as Microsoft Windows for Workgroups 3.11, Microsoft Windows NT 3.5, OS/2 LAN Server 4.0, and Unix networks. The NetPrint 1500 (\$795 with four ports) works with the NetWare IPX/SPX protocol. 800-243-2333, 617-647-1234; fax, 617-647-4474.

WinInstall Distributes Software Near and Far

As networks become more complicated and spread out, it's important for products to be flexible and adapt to network changes. **OnDemand Software** has announced WinInstall 5.0, which offers software distribution and file compression for both remote and wide area networks. WinInstall 5.0, scheduled for release by the time you read this, adds an ODBC (Open Database Connectivity) database to expand access to database packages. You'll also see enhanced integration with Microsoft System Management Server (SMS), plus new integration with Tally Systems' inventory and metering products, Bindview NCS, Novell NMS, and Legent Corporation's Distribulink.

WinInstall 5.0. List price: Ranges from \$5 to \$10 per user. *OnDemand Software Inc., Naples, FL; 800-368-5207, 813-261-6678; fax, 813-261-6549; e-mail, sales@ondemand.com.*

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NETWORK EDITION

New & Improved

McAfee Antivirus Tools Work Together

Well-integrated, flexible tools make a big difference in a network administrator's harried day. **McAfee Associates** has enhanced integration between its antivirus tools and now offers NetShield 2.2 and VirusScan 2.2. The tools, which both work with NetWare 4.1, boast faster virus detection and offer stronger management capabilities. NetShield 2.2 and VirusScan 2.2 share a virus-scanning engine and library and provide a new, easy-to-use Windows console.

NetShield 2.2. List price: Ranges from \$18 per user for 25 users to \$6.12 per user for 2,500 users.

VirusScan 2.2. List price: Ranges from \$65 for one user to \$12.40 per user for 2,500 users. Includes two-year subscription for free upgrades and unlimited telephone support. McAfee Associates Inc., Santa Clara, CA; 408-988-3832; fax, 408-970-9727; Web, <http://www.mcafee.com>.

Circle 966 on reader service card

BRIEFS

HARDWARE

Ten X Technology now offers CD-Access, which allows you to add CD-ROM drives, towers, and jukeboxes to Ethernet networks. CD-Access, which ranges in price from \$895 to \$4,995, attaches to your network with a 10Base-T connector. Then all you have to do is attach your CD-ROM device to CD-Access. 800-922-9050, 512-918-9182; fax, 512-918-9495; e-mail, tenx@zilker.net.

FarPoint Communications has introduced all/IO, a complete I/O card solution for attaching peripheral devices to your network. The all/IO card, priced at \$139, includes four high-speed serial ports and two EPP/ECP 1284 parallel ports. 805-726-4420.

3Com SuperStacks Are Super Switches

Speed, cost, and ease of use. In no other area are these three elements so critical as in switching. **3Com Corp.** announces a new generation of lower-priced SuperStack LinkSwitch switches, ranging from 10-Mbps switched Ethernet to ATM connections to the server and backbone. The LinkSwitch 1000 (scheduled for July release), the LinkSwitch 3000 Ethernet (scheduled for December release), and the LinkSwitch 2200 workgroup switches include multiple MAC addresses per port, cut-through and store-and-forward switching, SNMP management, ROM, and virtual LAN support.

SuperStack LinkSwitch 1000. List price: \$4,975.

SuperStack LinkSwitch 2200. List price: \$9,995.

SuperStack LinkSwitch 3000. List price: \$10,000. 3Com Corp., Santa Clara, CA; 408-764-5000; fax, 408-764-5001.

Circle 967 on reader service card

Now you can download the hottest new database development tool right from the Internet. Oracle Power Objects™ Developer's Release combines the power of enterprise-level client/server

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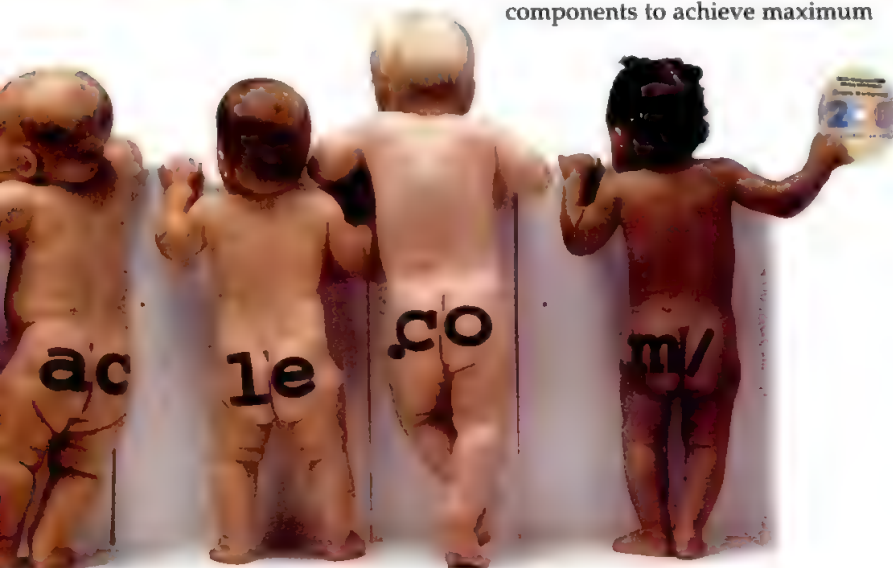
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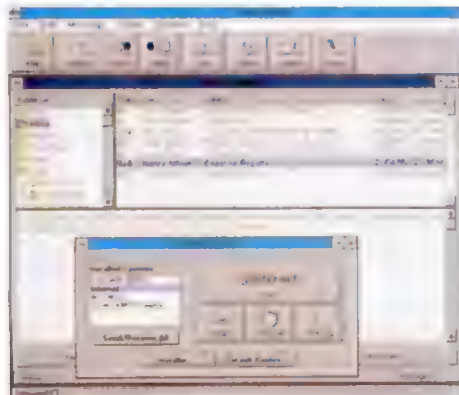
New & Improved

networkMCI Means Business

E-mail, faxing, paging, document conferencing, and Internet access. Wouldn't it be nice to have all these communication methods combined in one package? **MCI Telecommunications Corp.** now offers networkMCI Business 3.0, which does just that. messageMCI supplies you with a single address book for fax numbers, pager numbers, and addresses from multiple e-mail applications. infoMCI includes a research service and weekly news reports.

networkMCI Business 3.0. List price: \$100; free to current networkMCI customers. Monthly charges: \$35 for MCI long distance customers; \$45 for non-MCI customers. MCI Telecommunications Corp., Atlanta GA; 800-955-6505, 404-668-6000.

Circle 968 on reader service card



CALL ME: networkMCI Business packs all your communication needs into one package.

QuikStack Is an XLNT Stackable Switch

Stackable switches are useful for expanding your network without redesigning your network. **XLNT Designs** has announced the QuikStack line of stackable switches; they can be stacked up to five high. The QuikStack family includes the QuikEther Ethernet switch and QuikFDDI+ and QuikFDDI+4 Ethernet-to-FDDI switches. In addition to stacking them, you can build up to eight virtual networks from a single QuikStack switch. To make your life easier, XLNT includes an LCD, a keypad, and port LEDs on each QuikStack.

QuikEther. List price: With 8 ports, \$3,500; with 16 ports, \$6,400. **QuikFDDI+.** List price: \$9,999. **QuikFDDI+4.** List price: \$12,500. **XLNT Designs Inc.,** San Diego, CA; 800-956-8638, 619-487-9320; fax, 619-487-9768; Web, <http://www.xlnt.com>.

Circle 969 on reader service card

BRIEFS

HARDWARE

Digital Equipment Corp. has announced a new version of StorageWorks Controllers for its AlphaServer 1000/2100 and 8400 users. StorageWorks Controllers include more flexible RAID solutions and greater storage capacities. Earlier this year, Digital also introduced PCI and SCSI solutions. StorageWorks Controllers range in price from \$2,700 (StorageWorks HSD10 DSSI) to \$11,800 (StorageWorks HS240-BA). 800-786-7967.

NetWorth introduces the Series 1000 MicroHubs, available with up to 16 ports. The Series 1000 MicroHubs range in price from \$245 to \$565. Series 1000 MicroHubs also offer options for AUI, BNC, UTP, or fiber connectivity. 800-544-5255, 214-929-1700.

KOM now offers OptiServer for Windows NT (\$1,500 to \$15,000), a server for optical jukeboxes. It works with 5.25-inch, 12-inch and 14-inch optical jukeboxes. OptiServer is compatible with a variety of operating platforms, including HP-UX, Solaris, and SunOS. 800-668-1777, 613-599-7205.

Applied Network Technology announces the ANTswitch line, which includes four Ethernet switches and three add-on modules. The ANTswitch family of products includes Applied Network's patented distributed store-and-forward architecture. By implementing SNMP, ANTswitches work with such management systems as HP OpenView, IBM's NetView, and SunNet Manager. RMON capability lets you also use a remote client to view activity on network segments and ports. 508-392-0690.

Interphase Corp. has added 155-Mbps ATM adapters to its line of ATM products. The new adapters work with many different operating systems, including Macintosh System, Microsoft Windows NT, NetWare, and Solaris. ATM PCI adapters start at \$650, ATM EISA adapters at \$1,195, and GIO ATM adapters at \$1,295. 214-919-9000

Scalar Series Expands

Flexibility and upgradability are key when it comes to data storage. **Advanced Digital Information Corp.** (ADIC) now offers the Scalar DLT Series of digital linear tape-based automated data libraries, which allow you to expand up to eight DLT drives and 120 DLT cartridges. To manage data, Scalar products use a magazine-based approach, which divides data into subdivisions, such as projects, clients, or time periods. Scalar boasts a mean time between failure rating of over 80,000 hours at 100 percent usage. **Scalar DLT Series.** List price: \$33,000. **Advanced Digital Information Corp.,** Redmond, WA; 206-881-8004; fax, 206-881-2296.

Circle 970 on reader service card



STORAGE THAT GROWS: ADIC's data library is expandable and dependable.

LANtegrity for NetWare Offers Dual Powers

Data recovery and backup go together. Why? When a server goes down, due to an emergency or upgrade, users still need to be able to access files and applications as if nothing has happened. **Network Integrity** combines both instant recovery and backup in its LANtegrity for NetWare. LANtegrity protects multiple servers and up to 1,200 users. When LANtegrity steps in, you don't notice a difference but instead continue to see the same drives on the same server. LANtegrity also offers SNMP management, including a monitor to check access time.

LANtegrity for NetWare. List price: \$5,000 to \$12,500. **Network Integrity Inc.,** Marlboro, MA; 508-460-6670; fax, 508-460-6771; e-mail, info@netint.com.

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Logicode Quiktel 14,400 Fax/Modem. List price: Internal, \$159; external, \$189. Logicode Technology Inc., Camarillo, CA; 800-735-6442, 805-388-9000; fax, 805-388-8991.

Circle 972 on reader service card

BRIEFS

REMOTE

IBM Corp. has introduced SystemView Series software, which lets you install software from your network onto a remote PC and monitor the remote PC. IBM, which initially announced the SystemView architecture in 1990, continues to enhance its client/server technology with this new release. Initially, SystemView will work with IBM RISC System/6000 workstations. In the future you'll be able to use SystemView on additional platforms, including OS/2 PCs and IBM's mainframes and AS/400 minicomputers. Pricing is structured by feature. For example, one SystemView Software Distribution Server costs \$5,000, and each agent costs \$100. 800-426-2255

Sybase Offers Server 10 For UnixWare 2

The more network operating systems a product works with, the more flexible it is. **Sybase** has extended its reach with SQL Server RDBMS 10 for UnixWare 2, scheduled to be available by the time you read this. This relational database management system (RDBMS) uses UnixWare 2's symmetric multiprocessing (SMP) and TCP/IP and Novell SPX/IPX protocols to offer data management for heterogeneous client/server systems. SQL Server 10 for UnixWare 2 works with all operating systems supported by Sybase, including existing SQL Server for NetWare software.

SQL Server RDBMS 10 for UnixWare 2. List price: \$995 to \$40,000. Sybase Inc., Emeryville, CA; 510-922-3500; fax, 510-658-9441; Web, <http://www.sybase.com>.

Circle 973 on reader service card

MULTIPLE ACCESS By Cade Metz

The Trees for the Forest



Exploring the World-Wide Web may be hip, but it's not easy. Most Web publishers don't realize that a home page without publicity is like a ski slope without a ski lift: You can still get up the mountain, but it is infinitely more difficult. There is no way to access a site with only the help of a company name, and no omnipotent governing body that offers an up-to-date master index of home-page addresses.

This became painfully apparent recently when I was compiling a list of Web pages of ATM vendors. Expecting to finish the task in minutes, I telephoned various technical and customer-service contacts at each company, requesting the location of their Web sites. After 20 phone calls, however, I had only two HTTP addresses; furthermore, representatives at some major networking giants were claiming that they had never even heard of the Web. Annoyed, I brought up my browser to complete the list on my own.

Because I didn't have specific addresses in hand, I had to track down several independent search programs that locate documents via keywords. Two of the best are the WebCrawler at <http://webcrawler.cs.washington.edu/WebCrawler/Webquery.html> and the Yahoo index at <http://akebono.stanford.edu/yahoo/>. An extensive, hyperlinked list of search programs is available on *PC Magazine's*

own home page (<http://www.ziff.com/~pcmag>) as part of our recent top-100-Web-site compilation. These tools are a must when you're exploring the Web, but they are seldom comprehensive and never quick.

After lots of stop-and-go, I found several sites for companies that had just told me they didn't have a home page. Yet finding a Web address is only the beginning. Even with address in hand there is no guarantee that you will immediately be able to scroll through its text and graphics. Each site has a limit to the number of hosts that can access it at a particular time. It takes persistence to get onto popular addresses—such as the Yahoo site or Microsoft's home page—during standard East Coast business hours. I eventually completed my list, but not until well after business hours had passed.

A consolidated index would solve most Web access problems, but this is still a long way off. In the meantime, a more precise naming convention could help patch things up. If all addresses adhered to a format that is a direct function of a company's or an individual's name, that would cut down considerably on searches. Currently, a vast number of Web sites follow the unofficial standard, "<http://www.company-name.com>." If you know a name but not an address, a stab with this format is worth the effort.

For other approaches, the Robots, Wanderers, and Spiders site (<http://web.nexor.co.uk/mak/doc/robots/robots.html>) is the place to be. Not only does it provide access to all known exploration utilities, but it also supplies countless other pieces of information, including documents on how to write your own Web tools. We need all the Web help we can get. We can see the forest, but getting to a tree is another story. □



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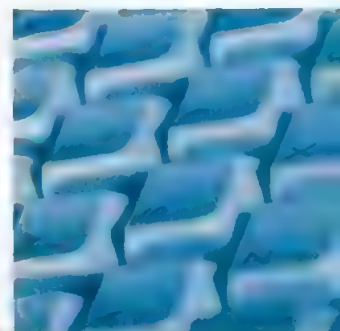
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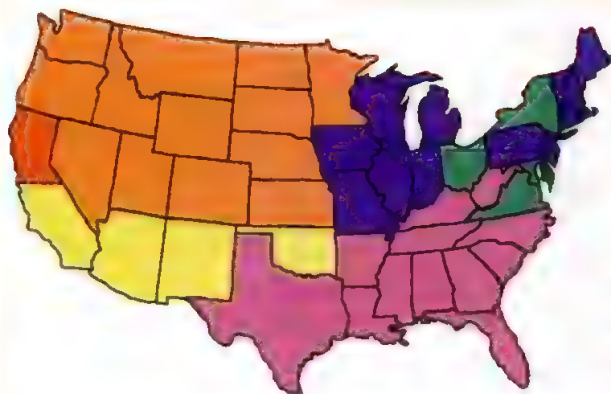
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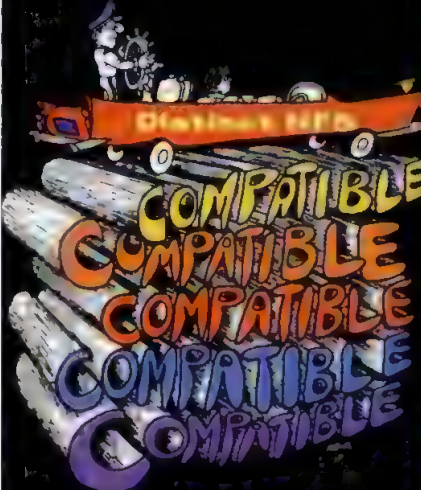
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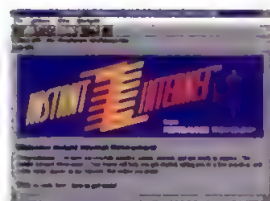
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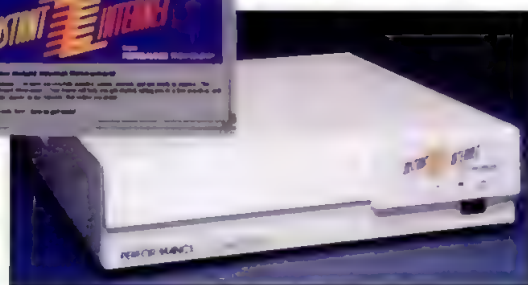
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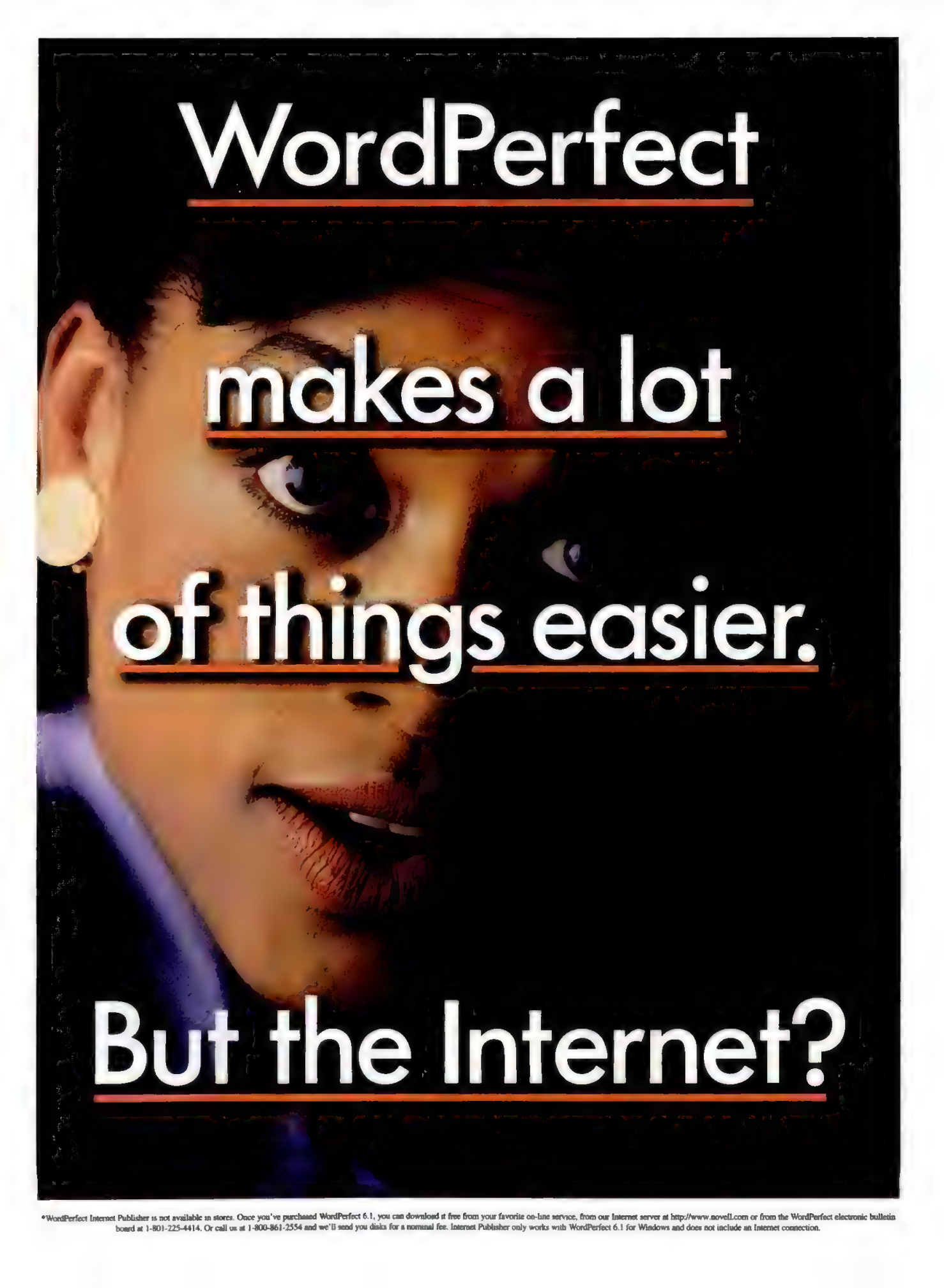
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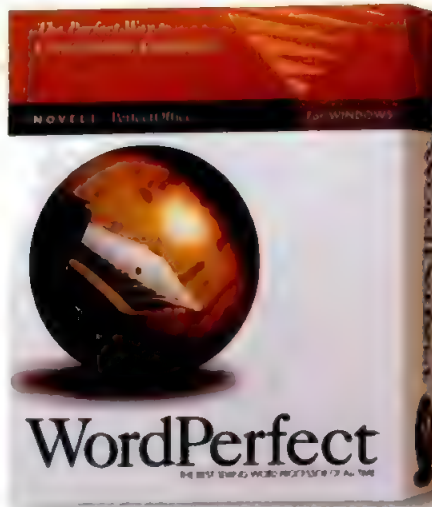
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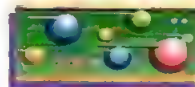
When the rush was on to introduce a notebook with a Pentium™ processor, Texas Instruments decided to do what others thought couldn't be done.

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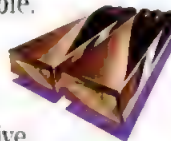
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MINI-TOWER CASES

"The only worthy upgrade [cases] I've found"

Ed Bott, *PC Computing*, October 1994



For a clean, easy-to-build system, there's nothing else like our economical **Personal Mini-Tower** enclosure. Features: small footprint, (3) 5-1/4" bays, (4) 3-1/2" bays (2 int.), a removable motherboard cage for easy assembly.

Specs: FCC-B, 16.7"D x 7.2"W x 15.5"H, 16lbs.
PERSONAL MINI-TOWER\$79



For a great-looking, heavy-duty, **USA-made** enclosure, choose our new **Solid-Steel Mini-Tower**. Features: (3) 5-1/4" bays, (3) 3-1/2" bays (2 int.), accepts a baby or full-size motherboard, assembles with removable drive cage.

Specs: FCC-B, 16.2"D x 8.5"W x 15.4"H, 23lbs.
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Eliminate the risk of network downtime or data loss due to power supply failure with the **TwinPower 900** redundant power system. It delivers high-capacity, fault-tolerant power to your entire network server.

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- 900 watts peak power
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Rear View

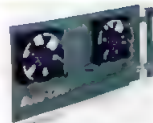
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486s and Pentiums run hot, often exceeding 185°F! Cool 'em by 70°-100°F with genuine, low-profile **CPU-Cool** coolers. Each consists of a long-life, ball-bearing, mini-fan *integrated* into a patented die-cast heat sink that easily mounts on the CPU. Powered by a spare drive plug. Last 10X longer and are 40% thinner than cheap, bulky imitations!
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CIRCLE 080 ON READER SERVICE CARD

The PERFECT PC

When it comes to PCs, what is perfection? It's not the last machine you'll ever buy, because we all know that new technology will make any machine you buy today obsolete eventually. It's not always the fastest machine or the one with the most features, because either might be too expensive for the job you want the machine to do. It's not always the least expensive machine, either, because that might not be able to do the job, or it might need premature replacement as new tasks and new applications stretch the system's limits.

Instead, the combination of features, performance, design, service and reliability, and price that best meets your needs defines what the perfect PC is for you.

In our fourth annual search for the perfect PC, we begin by listing the specifications of the machines that we think come closest to perfection. Our editors and the technicians and analysts at PC Magazine Labs spent months taking apart machines and running tests to identify the things you should be looking for in four types of desktop, three types of notebook, and two types of server.

Then we drill down, in a series of stories that take you inside each of the most important components in the PC, so you can better understand the technology and trade-offs involved. We

look at everything from the system unit itself to the display subsystem, hard disk, multimedia add-ons, and networking components. We also provide a pullout section that recaps the performance of machines we've tested recently and a worksheet that you can use to tally up the attributes of specific models you're considering.

This issue also includes results from our latest study of service and reliability, where readers rate PC manufacturers on reliability, repair service, and technical support—and tell us how often their machines needed repair in the first place. We report similar information for the most popular categories of business software, using results from our latest survey of software support and satisfaction.

Finally, we conclude with the *PC Magazine* Top 200, a list of the largest vendors of PCs, software, and peripherals, so you can better understand the companies behind the products you're interested in.

All of these elements together

give you an overview of all the facets of a PC—from the features our editors and analysts think are most important to the performance of individual systems to what your fellow readers thought of the machines they actually bought. We hope these insights will be just what you need to settle on the machine that is perfect for you.

—Michael J. Miller

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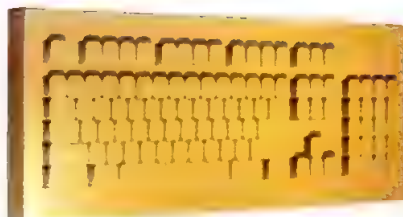
The PERFECT DREAM MACHINE

This is the machine you'd put on your desk if price were no object. It offers the fastest components and highest capacity available in a desktop PC today, providing no-holds-barred performance and features to those who can afford it. **Price: \$8,000.**



21-inch color monitor

A 21-inch monitor should comfortably support 1,280-by-1,024 resolution with a 75-Hz refresh rate or let you opt for 1,600-by-1,200 resolution.



Keyboard and mouse

If you're not content with the ergonomics of the keyboard and mouse that ship with your PC, you can get high-quality aftermarket alternatives for under \$100 each.

28.8-Kbps fax modem

Look for a V.34-compatible modem that supports a 28.8-Kbps data-transfer rate. An external model may be preferable, because it provides more status information. On the other hand, internal modems more typically provide telephony capabilities.

Mini-tower or tower case

A mini-tower case—about 15 inches tall—offers ample expansion space in a design that fits easily on a desktop. If you need more than the five to six drive bays mini-towers offer, consider a floor-standing full-size tower.

Dual floppy disk drive

5.25-inch floppy disks may be relics of the past, but a combo drive that supports them in addition to 3.5-inch disks lets you maintain compatibility without sacrificing another drive bay.

Quad-speed CD changer

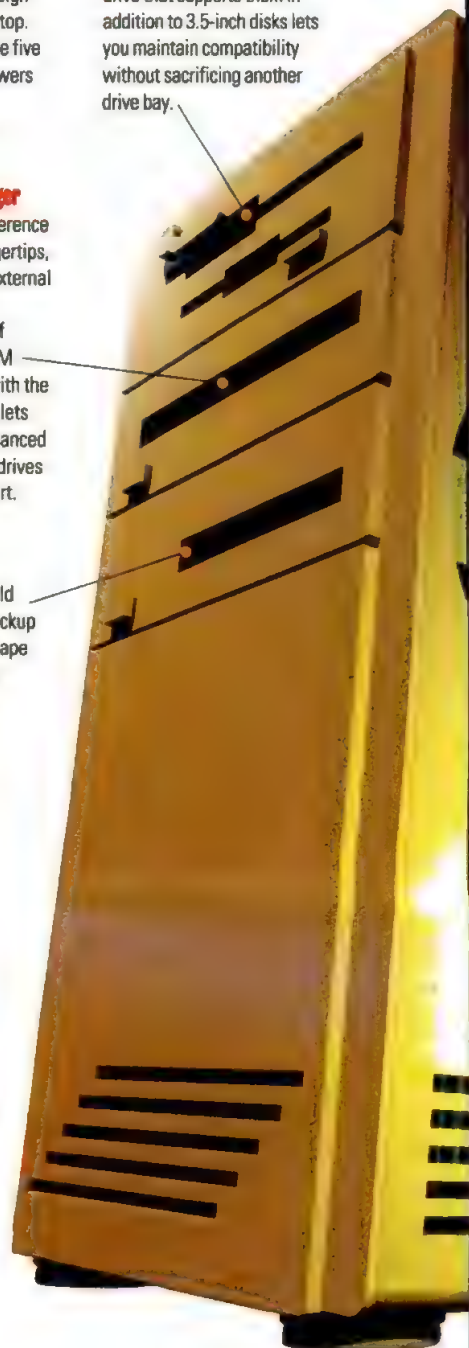
To keep a wealth of reference information at your fingertips, look for an internal or external CD changer or dual CD drives—quad-speed, of course. Internal CD-ROM drives should comply with the ATAPI standard, which lets them connect to an Enhanced IDE interface; external drives will require SCSI support.

DAT backup

Every high-end PC should have its own built-in backup solution. Digital audio tape (4-mm) offers both high performance and high capacity: 2GB to 8GB uncompressed.

512K of processor cache

A high-speed cache is crucial to keeping the CPU chugging along. Go with 512K if your motherboard supports it. *Synchronous* outperforms *asynchronous* cache.



1.6GB Enhanced IDE

Hard disk

Consider 1.6GB a starting point. In a single-user environment, Enhanced IDE is the preferred solution. Beyond 1.6GB, you'll need SCSI today.

200-watt power supply

Huge power supplies aren't as important as they once were. Make sure the power supply can enter a low-power mode that complies with Energy Star specifications. If you're bothered by its fan noise, consider an after-market power-supply upgrade with an ultraquiet fan.

10-/100-Mbps PCI

Ethernet NIC

Plug into today's 10-Mbps networks while building in an upgrade path to 100Base-T. ISA can't support high-speed networking, so you'll need to go with a PCI card.

PCI graphics card with 1MB of VRAM

4MB of video memory will give you 1,280-by-1,024 or 1,600-by-1,200 resolution with 16-bit color, or 1,024-by-768 with 24-bit true color. VRAM-based solutions are generally faster than those that use DRAM, and so-called 64-bit cards typically outperform 32-bit cards.

Wavetable-synthesis

Sound card

Your sound card should support 16-bit, 44.1-KHz stereo sampling and playback and use wavetable synthesis. To add even more realism, consider support for so-called 3-D sound.

32MB of EDO DRAM

Although 16MB of RAM is sufficient for everyday use, 32MB will let you keep more applications open and work on larger files without incurring time-consuming swaps to the hard disk. EDO (extended data out) DRAM boosts overall performance by a few percentage points.

PCI and ISA slots

PCI has rapidly become the dominant high-speed expansion bus; avoid VL-Bus. You'll also want ISA to maintain compatibility with hundreds of lower-speed expansion cards.

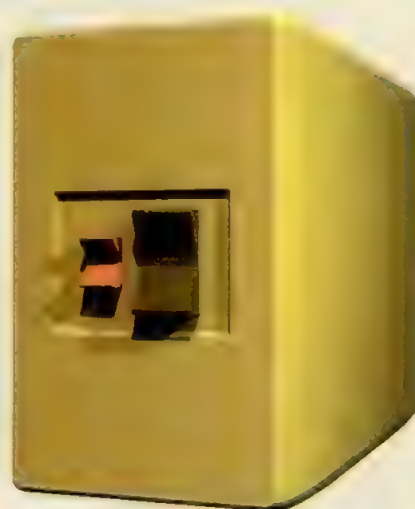
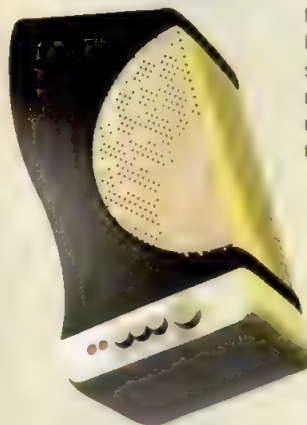
133-MHz Pentium CPU

The dream machine should have the fastest processor available. Currently that's a 133-MHz Pentium processor.



Three-piece speaker set

The dream machine's speakers should almost rival those of a quality stereo system. You'll want 10 to 20 watts per channel optimized for near-field (close-up) listening, as well as a subwoofer to add deep bass response and improve realism. Also consider a microphone and headphones.



450-wa UPS

An uninterruptible power supply will keep you from losing critical data when power fails. Get one with a volt-ampere (va) rating that's about a third larger than the combined wattage of your system unit and monitor.

The
PERFECT

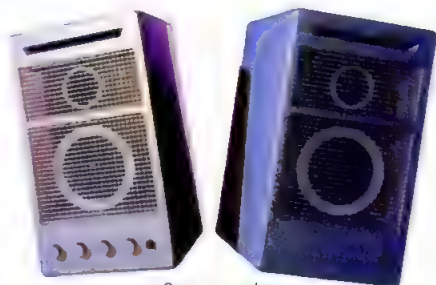
CORPORATE WORKSTATION

The perfect corporate workstation is the machine you should strive to put on every professional's desk-top in your organization; it is outfitted for productivity and reasonably priced. **Price: \$4,000.**



17-inch monitor

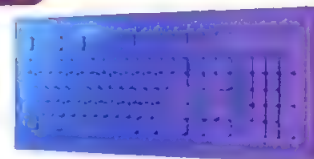
With 800-by-600 or 1,024-by-768 resolution, a 17-inch monitor lets you keep more windows open and see larger expanses of data than a 15-inch model.



• Stereo speakers

Mini-tower case

The mini-tower case offers more expansion than a desktop PC, doesn't raise the monitor to an uncomfortable height, and has a smaller footprint than a desktop case



3.5-inch floppy disk drive

Quad-speed CD-ROM drive

Even if you don't think multimedia is important in a corporate environment today, a CD-ROM drive will make loading software much easier. Look for one that complies with the ATAPI specification and connects to the system's Enhanced IDE interface.

1 or 2 available drive bays

Chances are you won't need to add many devices, especially since the most efficient means of backing up critical data may be shunting across the network to a server.

1GB Enhanced IDE hard disk

With hard disks selling for as little as 30 cents per megabyte, it doesn't pay to skimp on storage. Before you settle for a disk smaller than 1GB, remember that your operating system and a typical office suite will consume 100MB to 200MB.

256K of L2 cache

Anything less than 256K of L2 cache will hamper system performance; anything more won't help appreciably.

90- or 100-MHz Pentium CPU

The Pentium/90 and Pentium/100 are jockeying for the price/performance sweet spot. They're faster than 75-MHz chips but far cheaper than 120s and 133s.

16MB of RAM

For \$300 to \$400 more than an 8MB configuration, 16MB will dramatically boost performance and let you keep multiple applications open simultaneously.

16-bit sound card

A sound card capable of 16-bit, 44.1-KHz sampling and playback that supports FM synthesis adds less than \$100 to the overall system cost.

10-Mbps Ethernet NIC

Networking support is a must on any corporate PC; today, 10-megabit-per-second Ethernet predominates

PCI graphics board with 2MB of memory

2MB of video memory lets you use 1,024-by-768 resolution with 16-bit color or 800-by-600 resolution with 24-bit true color

14.4-Kbps fax modem

A V.32bis fax modem—or even a 28.8-Kbps V.34 model—lets you dial on-line services or access your PC remotely.

150-watt power supply

GRAPHICS WORKSTATION

Start with the corporate workstation—and then pump it up with a high-resolution monitor, scanner, printer, and input device, plus additional memory and processing power. **Price: \$30,000.**

21-inch monitor

Aside from the obvious—the ability to easily view a two-page spread on one screen—21-inch monitors let you run in high resolutions and high color depths without eyestrain. You can see your work in full without making it thumbnail-size, and there's enough screen real estate to dock all the tools you'll be using.

- 1,024-by-1,280 resolution

Price: \$2,500

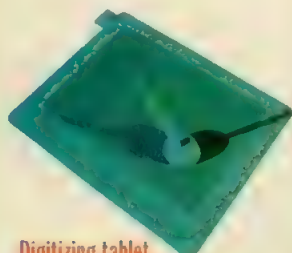


Scanner

Some artists use scanners to bring in images that can be used for collages or subtly altered.

- 24-bit color or better
- Scanner-calibration tools
- Transparency adapter

Price: \$2,000



Digitizing tablet

Every graphics pro needs a sketch pad. Some will rough out illustration ideas, others may create a simple layout.

- Puck for CAD use
- Pressure sensitivity

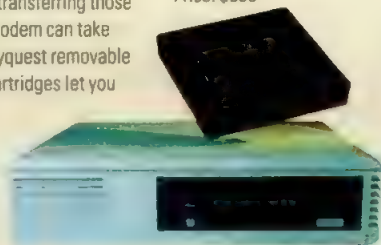
Price: \$400.

Removable storage

Graphics professionals often work with exceptionally large files, and transferring those files via modem can take forever. Syquest removable storage cartridges let you

send files to your service bureau in a format that is easy to transport and read.

Price: \$500



High-end color printer

Want to see how your art or designed page will look in the final publication? Thermal dye sublimation will give you near-photographic-quality output

- PostScript printing
- Super B-size printing capabilities (11.8- by 19.3-inch maximum sheet size)

Price: \$14,000



Video-capture card

Increase your clip-art collection by grabbing still and moving images from video

Price: \$700

High-end graphics accelerator card

Supporting 16.7 million colors at high resolutions (1,024-by-768 or better) requires 4MB of RAM on the graphics card. 8MB of fast VRAM is better

Price with 4MB: \$800

Price with 8MB: \$1,800

Dual-processor support

Dual processing (supported by Microsoft Windows NT 3.5) can vastly speed up image editing and 3-D rendering.

Price: \$1,200

Pump up the RAM

Products like Adobe Photoshop recommend users have at least 32MB of RAM. To work with high-res images you'll want four times that.

Price for four 32MB SIMMs: \$6,000



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- Choice of Kensington Traveling Tote Case or Compaq Backpack

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- Weighs only 5.9 lbs.
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Contura 410 Option Paq

- Additional 4MB RAM
- Compaq 192 PCMCIA Fax Modem
- Enhanced NiMH Battery Pack
- Kensington Executive Traveling Case

Only \$589



LTE Elite 4/75C

- 486DX4/75MHz Processor
- 8MB RAM
- 340MB Removable Hard Drive
- 9.5" Color Dual Scan Display
- Built-In AC Adapter
- Two PCMCIA Type II Slots
- 3.5" 1.44MB Diskette Drive
- Built-In Enhanced EasyPoint Trackball
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You'll find expansion options for all Compaq notebooks: the Convenience Base for the Contura Aero, the Docking Base with optional Ethernet for the Contura 410, and the SmartStation Expansion Base for the LTE Elite. The SmartStation Expansion Base includes integrated Ethernet, drive bays, ISA slots, and integrated SCSI 2 — giving the LTE Elite full-function desktop capabilities. And for a limited time, it's FREE with the purchase of select LTE Elite models.** For more information, call us today.



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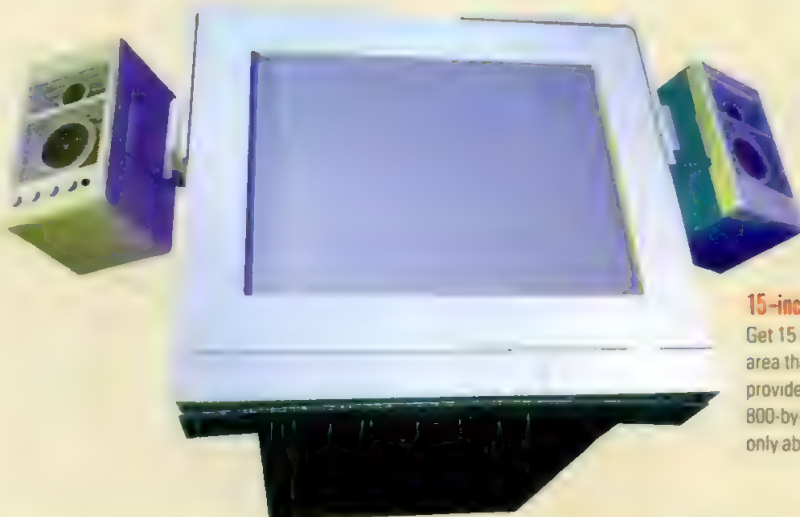
Ask for the man in the blue shirt

The PERFECT ENTRY-LEVEL SYSTEM

This system is ideal for office-automation tasks such as word processing and e-mail correspondence. With a few extra components, it can be an inexpensive multimedia or small-office/home-office machine. **Price: \$2,000.**

Speakers

As multimedia becomes ubiquitous, an inexpensive pair of basic speakers is a must. Consider spending \$50 to upgrade from low-quality bundled models.



Integrated SVGA graphics

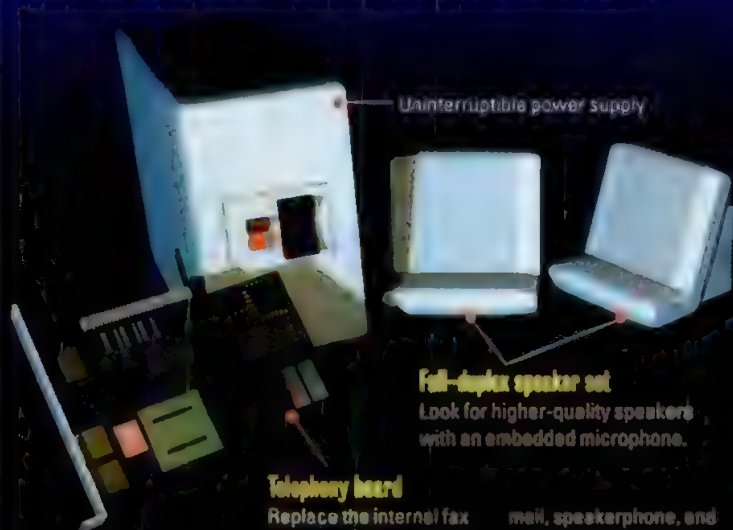
1MB of DRAM supports 800 by 600 resolution with 16-bit color (65,000-plus shades).

15-inch monitor

Get 15 percent more viewing area than a 14-inch monitor provides—just enough for 800-by-600 resolution—for only about \$100 more.

SMALL-OFFICE / HOME-OFFICE UPGRADE

Add these components to turn the entry-level system into a capable SOHO machine. Upgrade price: \$1,000.



Uninterruptible power supply

Full-duplex speaker set

Look for higher-quality speakers with an embedded microphone.

Telephony board

Replace the internal fax modem with a telephony board that supports voice-

mail, speakerphone, and features such as distinctive ring and caller ID.

Software bundle

For a productivity-oriented PC, you'll want an office suite and reference material. For an edutainment machine, look for personal-finance, medical, reference, and game titles.

Travan tape-backup unit

For less than \$200, you can back up your data using a Travan drive with 800MB capacity.

Wavetable-synthesis upgrade

16MB of RAM

For \$300 to \$400, an extra 8MB of RAM will provide for better performance,

along with the ability to keep many more applications open at once.

PCI and ISA slots

Since many components are integrated onto the motherboard, two or three expansion slots on a riser card may be all you will need. Make sure the system supports PCI, keep ISA for backward compatibility and slower peripherals.

14.4-Kbps fax modem

An internal V.32bis fax modem that costs less than \$100 will let you access on-line services or send and receive faxes and e-mail.

Slimline or mini-tower case

Expandability isn't critical in an entry-level system, but make sure there's one bay free for a tape-backup unit.

Sound Blaster-compatible audio

Look for 16-bit, FM-synthesis stereo sound that is compatible with the Creative Labs Sound Blaster standard.

At least 8MB of RAM

Today's Windows applications won't run effectively if you have any less than 8MB of RAM. Consider upgrading to 16MB for an additional \$300 to \$400.

256K of L2 cache

Don't skimp on cache; performance will suffer. But don't go overboard, either. Expand system RAM before you think about going to a 512K cache.

150-watt power supply

Lightly configured systems don't use much power.

75-MHz Pentium CPU

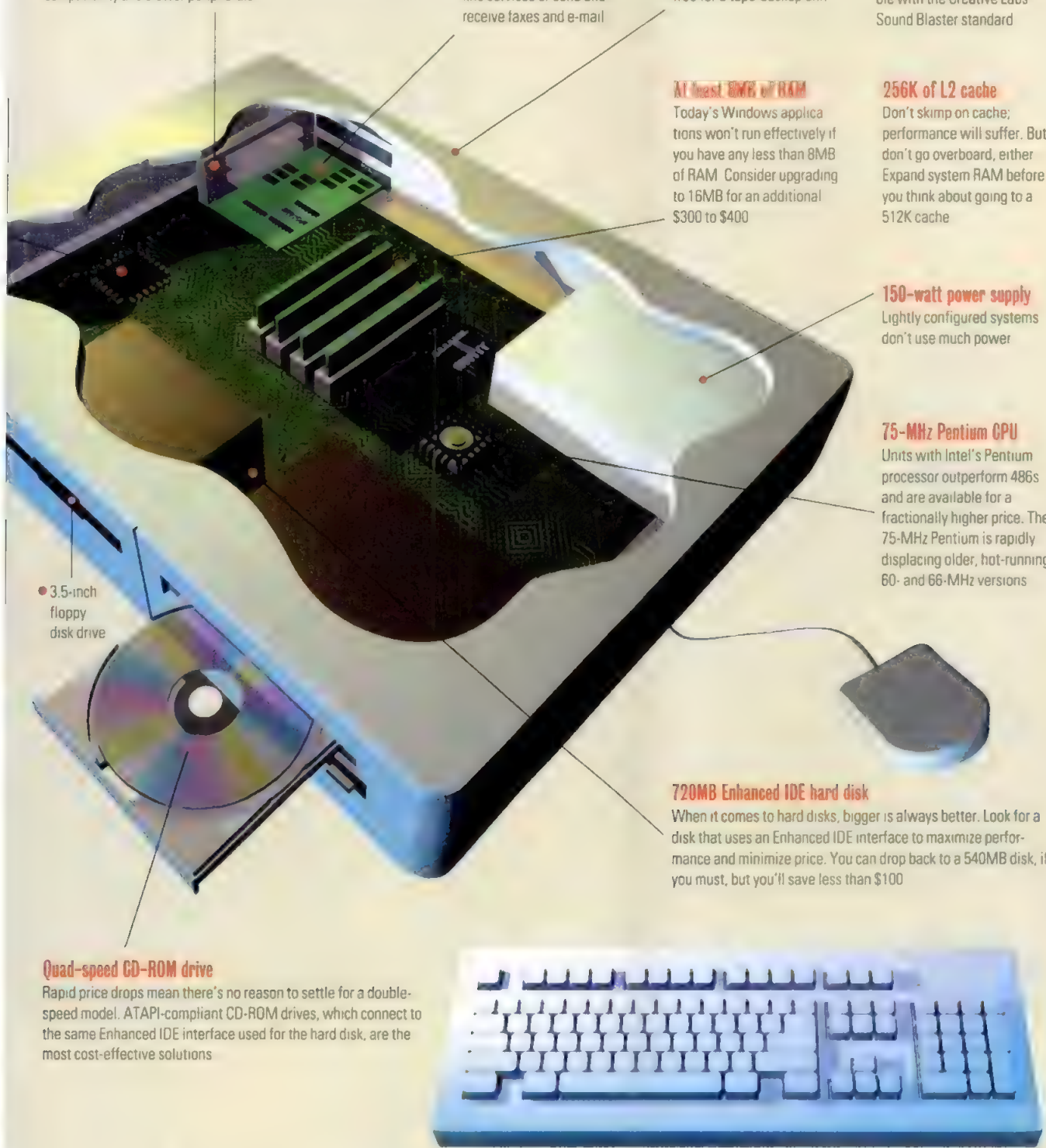
Units with Intel's Pentium processor outperform 486s and are available for a fractionally higher price. The 75-MHz Pentium is rapidly displacing older, hot-running 60- and 66-MHz versions.

720MB Enhanced IDE hard disk

When it comes to hard disks, bigger is always better. Look for a disk that uses an Enhanced IDE interface to maximize performance and minimize price. You can drop back to a 540MB disk, if you must, but you'll save less than \$100.

Quad-speed CD-ROM drive

Rapid price drops mean there's no reason to settle for a double-speed model. ATAPI-compliant CD-ROM drives, which connect to the same Enhanced IDE interface used for the hard disk, are the most cost-effective solutions.





© 1995 Intel Corporation. *Source: iCOMP®: A Simplified Measure Of Relative Microprocessor Performance. Intel Corporation, 1992.†† The 63 MHz Pentium OverDrive processor for most 50 MHz and 25 MHz Intel486® CPU based systems is available now. The 83 MHz Pentium OverDrive processor for most 66 MHz and 33 MHz Intel486 CPU based systems will be available later in the year. *Other trade names referenced are the property of their respective holders.

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FULL-FEATURED NOTEBOOK

If your notebook is your primary PC and needs to be every bit as capable as a fully loaded desktop, here is what it should include. **Price: \$7,000.**

11.3-inch SVGA active-matrix LCD

An 11.3-inch LCD panel provides nearly as much usable viewing area as a 14-inch CRT, and 800-by-600 SVGA support lets you view 50 percent more information than a 640-by-480 VGA screen. The largest screens today are 10.4 inches; 11.3-inch displays will come to market by summer's end. An active-matrix panel is a must for presentations, although backing down to a dual-scan display will save about \$800.

Security

Look for a way to chain your notebook down, try a hardened steel eyehole or a plug for a Kensington lock.

Integrated pointing device

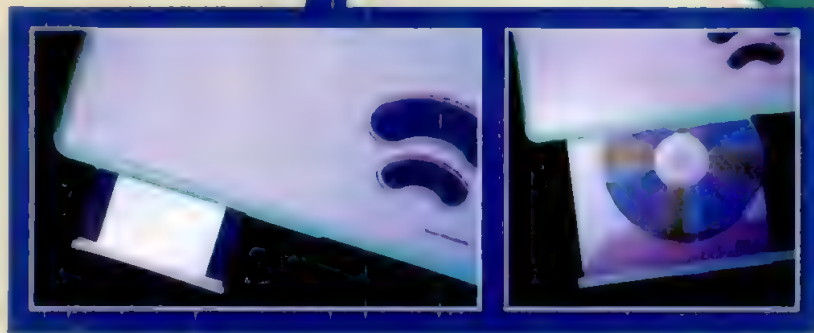
Look for the one that best suits your working style. Some manufacturers let you choose from multiple options for any given notebook. (Alternative designs are shown on the facing page.)

1.2GB hard disk

Large hard disks for notebooks are in tight supply; a 780MB disk is reasonable.

Removable floppy disk drive CD-ROM drive

For maximum flexibility, your notebook should let you choose what you want to take along: a floppy disk drive, a CD-ROM drive, or even a spare battery (shown below).



● 16MB of RAM

PCI graphics with 2MB

At least 2MB of graphics memory is necessary for 800-by-600 support with 24-bit color; it also lets you drive external monitors at 1,024-by-768 with 16-bit color. Look for a machine that supports high refresh rates—72 Hz or better—on external CRTs to provide flicker-free presentations

Lithium ion battery

Lithium ion batteries will give you 2 hours or more of continuous usage, even with a fully loaded notebook. This compares with only 60 to 90 minutes for nickel hydride units

90-MHz Pentium CPU

Intel now makes a 2.9-volt version of the Pentium/90, which draws about 25 percent less power than the 3.3-volt desktop version. This P54LM chip comes in a tape-carrier package that mounts directly on the motherboard to save space and weight. Coming soon: 2.6-volt Pentium/120s

256K processor cache

You wouldn't buy a high-end desktop Pentium system without a cache, and the best way to achieve comparable performance in a notebook is to employ a cache—even though it adds size and bulk and consumes more power

16-bit wavetable-synthesis sound

Wavetable synthesis can be achieved by leveraging the capabilities of the DSP chip used for the modem

- Stereo speakers

PCMCIA

Look for a PCMCIA slot that can accept two stacked Type II PC Cards or a single Type III PC Card

• Microphone

• Infrared port • Docking-station port

• Full-size parallel port

• VGA port • Line-in, line-out, speaker, and microphone ports • Security slot

28.8-Kbps fax modem with telephony

An integrated fax modem with a built-in RJ-11 jack is a must in a high-end notebook (although few offer this

feature) and a V.34 model lets you download information in half the time taken by a 14.4-Kbps V.32bis

modem. Vendors that use DSP chips to provide this capability often also support speakerphone and voice-mail features

• Serial port

• Keyboard port

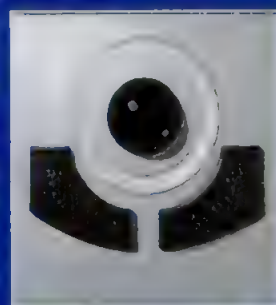
Integrated AC transformer

A built-in transformer means no ungainly external brick to carry around; just plug it into the wall with a Euro-

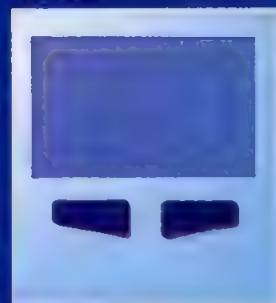
pean-style shaver cord. The catch: Most internal transformers demand small fans to help dissipate heat.

Pointing devices

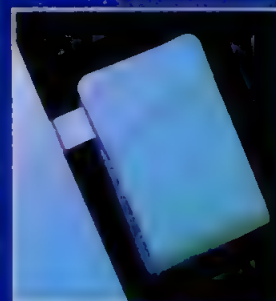
In addition to the integrated pointing stick on the opposite page, you're likely to see three variations of built-in mouse substitutes. The trackball is often mounted into the notebook's wrist rest or, less conveniently, on the cover next to the LCD panel. A touch pad lets you control the mouse pointer by moving your finger across a touch-sensitive surface. HP's unique miniature mouse pops out of the side of the notebook, it's tethered by what looks like a flexible plastic popsicle stick.



Trackball



Touch pad



Miniature mouse



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It's good to know that, whether your criteria emphasize value or performance, Austin offers you a choice of award-winning Pentium technology PCs. Two of Austin's PowerPLUS systems the PowerPLUS-75 and the PowerPLUS-100 were awarded the Editors' Choice by *PC Magazine*. A third system – the PowerPLUS 120 – won an honorable mention.

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PowerPLUS-100

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- 100MHz Intel Pentium Processor
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- Energy-Star Compliant
- Desktop or Mini-Tower Chassis

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- 16MB High-Speed RAM
- 1GB Bus Mastered IDE HD
- 4X IDE CD-ROM Drive, 16-Bit Audio Card, and Stereo Speakers
- 17" 28mm Non-Interlaced Monitor
- 28.8Kbps Internet Surfboard
- Microsoft Office Professional 4.3 Bundle
- Business Lease: \$129/mo.

\$3,599

PowerPLUS-90

Editor's Choice

- 90MHz Intel Pentium Processor
- 256KB L2 Cache
- 64-Bit PCI Video Accelerator - 1MB
- 3.5" 1.44MB Diskette Drive
- MS-DOS 6.22, Windows for Workgroups 3.11
- 101-Key Keyboard & MS Mouse
- Energy-Star Compliant
- Desktop or Mini-Tower Chassis

Business Workstation

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- 850MB Bus Mastered IDE HD
- 15" 28mm Non-Interlaced Monitor
- Business Lease: \$76/mo.

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Multimedia Workstation

- with Microsoft Office Professional 4.3 Pre-installed
- 16MB RAM
- 1GB Bus Mastered IDE HD
- 4X IDE CD-ROM Drive, 16-Bit Audio Card, and Stereo Speakers
- 15" 28mm Non-Interlaced Monitor
- Microsoft Office Professional 4.3 Bundle
- Business Lease: \$107/mo.

\$2,799

PowerPLUS-75

Editor's Choice

- 75MHz Intel Pentium Processor
- 8MB RAM
- 256KB L2 Cache
- 64-Bit PCI Video Accelerator - 1MB
- 3.5" 1.44MB Diskette Drive
- MS-DOS 6.22, Windows for Workgroups 3.11
- 101-Key Keyboard & MS Mouse
- Energy-Star Compliant
- Desktop or Mini-Tower Chassis

Business Workstation

- 540MB IDE HD
- 15" 28mm Non-Interlaced Monitor
- Business Lease: \$69/mo.

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Multimedia Workstation

- with Microsoft Office Professional 4.3 Pre-installed
- 700MB IDE HD
- 4X IDE CD-ROM Drive, 16-Bit Audio Card, and Stereo Speakers
- 15" 28mm Non-Interlaced Monitor
- Microsoft Office Professional 4.3 Bundle
- Business Lease: \$88/mo.

\$2,299

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Even though it's lighter than most notebooks, the Austin StepLite delivers DX4 power, a full-sized keyboard, convenient trackball, and PCMCIA expansion. In short, the Austin StepLite is a heavy-hitting road warrior hidden in a tough, 4.8-pound package. And the StepLite outperforms puny subnotebooks! For example, the 9.5" screen is 21 percent larger than the Toshiba Portégé display. To withstand the hard knocks that come with a heavy travel schedule, the StepLite's case is 50% thicker than the competition's.

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- 14.4K Internal Fax/Modem
- Weight with Battery: 6.8 lbs.
- Microsoft Office Standard 4.2
- Business Lease: \$137/mo.

Austin Vista 486DX4-100 \$3,099

- 100MHz Intel 486DX4 Processor
- 11.3" DSTN Display (Local Bus Video)
- 8MB RAM (expandable to 28MB)
- 703MB Hard Drive (Local Bus IDE)
- 2 Type II or 1 Type III PCMCIA Slots
- Integrated Pointing Stick Mouse
- EPP/ECP Parallel, 16550 High-Speed Serial, Keyboard, SVGA Ports
- 16-Bit Business Audio Features: Built-in Microphone and Speaker, External Jacks for Line-In/Line-Out
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CIRCLE 012 ON READER SERVICE CARD

The PERFECT SUBNOTEBOOK

The defining feature of the subnotebook is the outboard floppy disk drive that you can leave behind to shed weight and bulk. This is a road warrior's dream system: full-featured, with a travel weight of only 5 to 6 pounds. **Price: \$5,000.**

10.4-inch color TFT panel

Although 9.5-inch LCD panels are more typical in subnotebooks, a bigger screen makes viewing easier. Active-matrix TFT color screens provide sharper images than dual-scan passive-matrix LCDs. By the end of the year, expect to see 800-by-600 SVGA panels migrate into high-end subnotebooks.

On-board PCI graphics

Notebook graphics performance often substantially lags that of desktops. PCI-based graphics solutions help bridge the gap.



Expanding keyboard

This is IBM's clever solution to packing a full-size keyboard into a smaller-than-usual case. The "butterfly" keyboard is split into two parts that overlap when the case is closed and expand into a standard configuration when it is opened.



• Speaker

• Microphone

Internal pointing device

The choice of pointing device is a highly personal one. Because of space constraints in a subnotebook, a pointing stick may be the most efficient solution.

• DX4/100 or Pentium/75 CPU

• 16MB of RAM

Removable 540MB or 720MB hard disk

Opt for the largest hard disk you can get. A removable hard disk makes it easier to salvage data if your notebook fails.

PCMCIA slots

Look for stacked slots that can accommodate two Type II PC Cards or a single Type III PC Card.

Lithium ion battery

Lithium ion batteries offer higher power density than more common nickel/hydrate models—oftentimes enough for a coast-to-coast flight.

• External 3.5-inch floppy disk drive

• Power

• Infrared port

• Docking-station connector

Internal fax modem

Look for an internal V.32bis (14.4-Kbps) or V.34 (28.8-Kbps) fax modem and built-in RJ-11 jack.

Full-size parallel, serial, VGA, and keyboard ports

Watch out for shrunken proprietary ports that require you to take along adapter dongles.

• Security slot

External power adapter

The Best Features

Gateway 2000® beats the competition to the punch with the world's best features!



The multimedia world gains major ground with the introduction of Gateway's 4X three-CD changer! Load this fast 4X CD-ROM drive with three CDs and you have 1.8GB of data at your fingertips. The 4X three-CD changer is either standard or available as an upgrade option on all Gateway desktop systems. All Gateway systems with 4X CD-ROM drives give you a 600KB data transfer rate for true full-screen, full-motion video and it's ATAPI compliant and ready for Windows™ 95.

Software

You can have action and excitement for the whole family — and the tools to conquer all *your* special missions. Gateway outfits you with incomparable software applications on all our systems. Choose a Family PC™ multimedia system and be transfixed by Gateway's new Generations Software Collection including 51 software programs! Professional Gateway PCs include Microsoft® Office Professional 4.3, the world's number-one selling software suite. And all Gateway desktop PCs include MS Windows for Workgroups 3.11 — the fastest version of Windows available (today).

Vivitron™ Monitors

Electric color, a razor-sharp focus and crystal clear images — all from a Gateway 15- or 17-inch Vivitron monitor! These monitors feature Sony® Trinitron® tube technology — technology that the most discerning viewers have relied on for decades.

The Best Service and Support

Gateway 2000 delivers another powerful blow to the competition by providing all our customers with award-winning, toll-free technical support for the life of their Gateway system! All Gateway desktop systems and monitors are also covered by a three-year limited warranty. Write or call us for a free copy of our warranty.

The Best Quality

For nearly 10 years, Gateway 2000 prevails when it comes to bringing PC buyers the highest-quality computer components available — the best we can possibly offer. The evidence speaks for itself with the MS Mouse, Gateway's programmable AnyKey® keyboard, and of course, our trademark cow-



It's A Quick Getaway With

"Home free," thinks Agent 2000. Just then the flight attendant approaches, "Hello Agent 2000, and welcome to Ambush Airlines. May I place your briefcase in the overhead compartment? No? Well then, perhaps a better place is smashed upside your head!" Agent 2000 knows it's now or never. Prying open the airplane door, 2000 checks the combination compass/wind-velocity chart, jumps, and lands only a tractor ride away from Gateway 2000 headquarters!

The Best Portable PCs

Don't be fooled by stripped-down portables posing as great values. They'll just leave you up in the air without the performance that you really need. Outsmart them by choosing Gateway 2000's high-performance portables, the Liberty™ and ColorBook.™ They're loaded with the power to handle the increasing demands of today's (and tomorrow's) technology.

Performance

When your special assignments take you out in the field, have outstanding performance without anything to weigh you down

power with 256K L2 cache for Pentium® processor-like performance. Gateway also gives you plenty of RAM that will increase battery life and improve your overall system performance! With 24MB RAM and a 720MB hard drive, the Liberty DX4-100 Best Buy gives you the speed and power to run all your hard core applications without a snag.

Features

The Liberty's sleek 4.2-pound design delivers all the goods with a 10.4-inch screen, infrared technology, an impressive battery life and incredible software applications are installed



Gateway 2000's portable PCs — the ColorBook² and Liberty

GATEWAY 2000[®] LIBERTY[™]

- 4.2 Lbs., 10" x 8" x 1.6"
- 10.4" DSTN Color Display
- 1MB Video RAM
- Choice of Desktop IR Receptor or External Floppy Drive
- Intel[®] 486 DX2 or DX4 Processor
- Instant On
- NiMH Battery & AC Pack
- 2 PCMCIA Type II Slots
- EZ Point[™] Integrated Pointer
- Removable Hard Drive
- 78-Key Keyboard
- Parallel, Serial, VGA & PS/2[®] Ports
- OAG[®] FlightDisk[®], World Clock, & Ascend[®] personal information manager (PIM) for use w/ Franklin Day Planner[®]
- MS-DOS[®] 6.22 & WFW 3.11
- Microsoft[®] Works for Windows[™] 3.0 or MS Office Professional 4.3**

LIBERTY DX4-100 Base

10.4" DSTN Color Display, 8MB RAM, 340MB HD, MS Works

\$2999

DX2-50 \$2749

LIBERTY DX4-100

10.4" DSTN Color Display, 12MB RAM, 540MB HD, 256K L2 Cache, MS Works

\$3499

LIBERTY DX4-100

Best Buy 48-Hour QuickShip[®]

10.4" DSTN Color Display, 24MB RAM, 720MB HD, 256K L2 Cache, TelePath[™] 14.4 XJACK[®] Fax/Modem, Extra Battery, Leather Carrying Case, Desktop IR Receptor, External Floppy Drive, MS Office Professional 4.3**

\$4499

COLORBOOK²

- 5.7 Lbs., 11.65" x 8.5" x 1.77"
- 10.3" DSTN Color Display
- Intel 486 DX4 Processor
- Minimum 8MB RAM (expandable to 24MB)
- 1.5MB Video RAM (includes 512KB cache)
- Removable Hard Drive
- 3.5" Diskette Drive
- Integrated 16-Bit Sound and Speaker
- NiMH Battery & AC Pack
- EZ Point Integrated Pointer
- 2 PCMCIA Type II Slots
- 85-Key Keyboard
- Parallel, Serial, VGA & PS/2 Ports
- MS-DOS 6.22 & WFW 3.11
- MS Works for Windows 3.0 or MS Office Professional 4.3**

COLORBOOK² DX4-100

8MB RAM, 340MB HD, MS Works 3.0

\$2999

COLORBOOK² DX4-100 Deluxe

8MB RAM, 540MB HD, TelePath 14.4 Fax/Modem, Carrying Case, MS Office Professional 4.3**

\$3499

COLORBOOK² DX4-100 Best Buy

16MB RAM, 720MB HD, TelePath 14.4 Fax/Modem, Carrying Case, MS Office Professional 4.3**

\$3999

LIBERTY PROFESSIONAL PACK

MS Office Professional 4.3, PCMCIA TelePath XJACK 14.4 Fax/Modem, Extra NiMH Battery, Leather Carrying Case

\$449

**48-Hour QuickShip program applies only to the Liberty DX4-100 Best Buy configuration. Your PC will be delivered within two business days from the time of order. No additions or deletions can be made to the configuration. Available for approved credit card orders only while quantities last. Domestic U.S. orders only. Call us for details about other QuickShip offers.*

***MS Office Professional 4.3 includes Word, Excel, PowerPoint[®] presentation graphics program, and Access[®] database.*

SERVICE AND WARRANTY

- Lifetime portable-specific toll-free service and support
- One-year limited parts warranty
- 30-day money-back guarantee
- Special VIP warranty. We'll ship a replacement to you within 24 hours during warranty. Only available at the time of purchase for an additional \$100.

PERIPHERAL OPTIONS

- Panasonic[®] KXL-D720 external CD-ROM drive **\$299**
- ColorBook² port replicator **\$49**
- PCMCIA 14.4 XJACK send/receive fax/modem **\$159**
- PCMCIA network adapters, twisted pair **\$129**
- Coaxial adapters **\$159**
- Token Ring adapters **\$399**



Toll free from Canada
800-846-3609



Toll free from Puerto Rico
800-846-3613

PORTABLE SALES

8 0 0 - 8 4 6 - 4 3 2 0

610 Gateway Drive • P.O. Box 2000 • N. Sioux City, SD 57049-2000 • Phone 605-232-2000 • TDD 800-846-1778 • Fax 605-232-2023 • FaxBack 800-846-4526
Component Add-On Sales 800-846-2080 • Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

With a firm grip
still on the metallic
briefcase, Agent 2000
arrives at Gateway 2000
headquarters and is
ushered into President Ted
Waitt's office. There two
Teds stand face-to-face!

"You've arrived with
the Secret Code intact!"
exclaimed Ted.
"Excellent! Good work
Agent 2000!"

With that, Agent
2000 removes her mask:
it's Undercover Agent
Monique! "Thanks
Ted," she replied. "I could hardly wait to get back to North
Sioux City. Just what is this code name 'mon z-mopuim?' Is it a new kind of mouse
pad design?"

"No, no 2000," chuckled Ted, "much more important to our customers than that. But
I'm afraid you were so expedient in returning that it's too soon to tell you. You see, there is
a time-release lock on that briefcase. Anyone who opened it early would've activated an
ink spill in the briefcase and destroyed the Secret Code!"

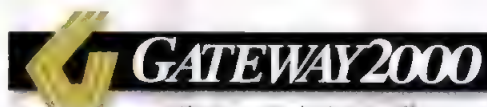
"Can't you please give me just a little hint?" pleaded 2000.

"Well, while you were on this special assignment, I was back here finding a way to
bring Gateway 2000 customers all the newest technology with Windows 95!" exclaimed
Ted. "The Secret Code is a way to get Microsoft's new operating system on a value-packed
Gateway PC that's optimized for Windows 95! This combination of superior system
performance and Windows 95 will revolutionize the way PC users compute! It's all part of
Gateway 2000's formula of bringing customers the latest technology for the best PC values
on the planet. **For details about the Gateway's Windows 95 Secret Code, customers
can call us at the 800 number below and ask!"**

"Brilliant Ted!" exclaimed 2000. "I can hardly wait to get the Secret Code to
Windows 95."

"Yes, the wait will soon be over," said Ted. "Thanks again, 2000. Oh, you didn't run
into any problems did you?"

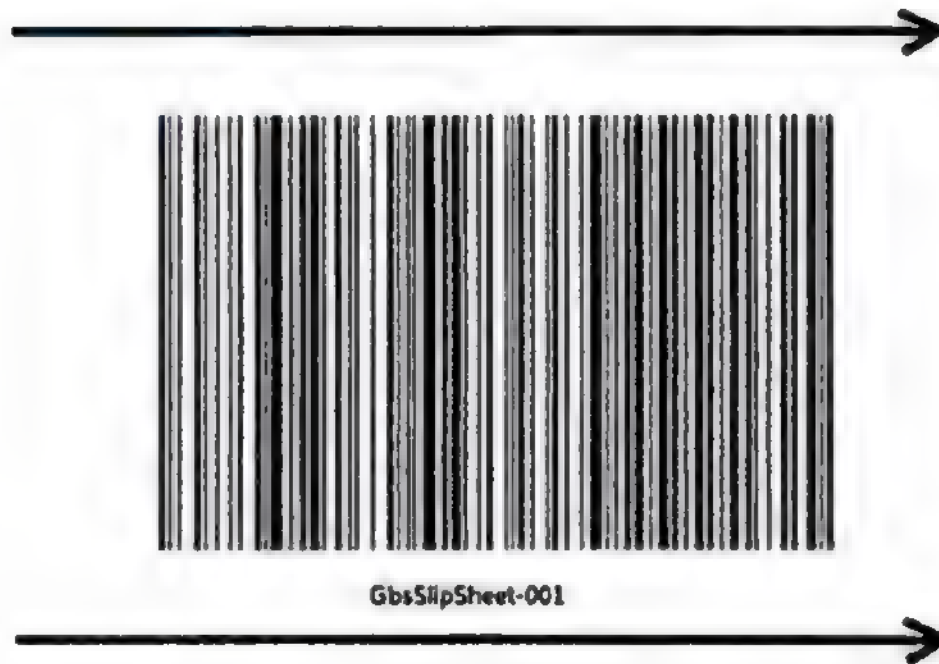
"Nah, piece of cake," she replied.



"You've got a friend in the business."

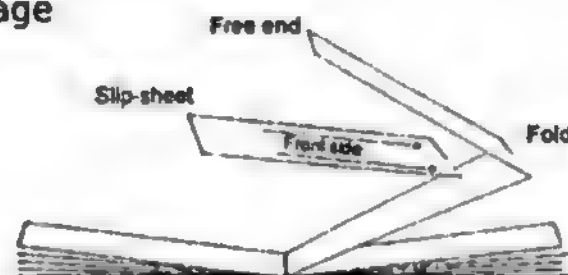
8 0 0 - 8 4 6 - 2 0 6 3

Inverted Foldout slip-sheet



Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page

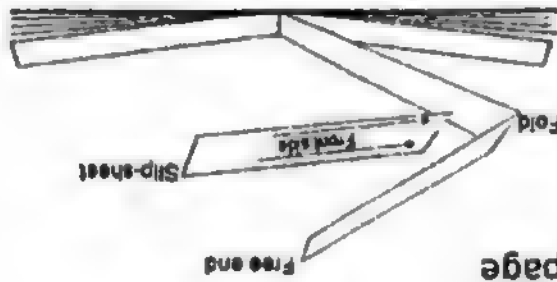
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

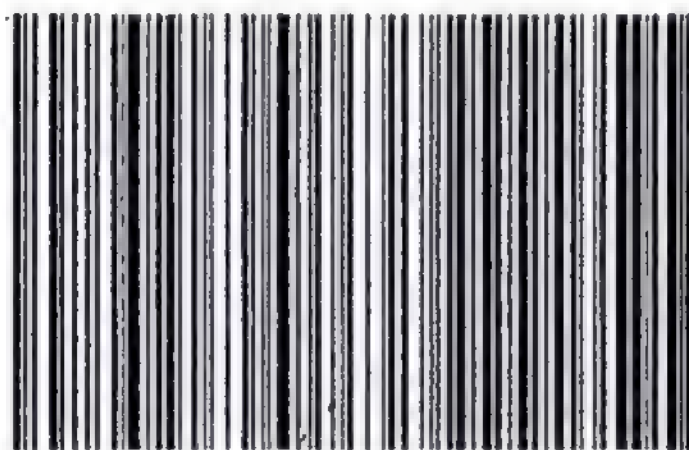
3. Slice the folded edge

4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



Gbs5lipBack-0018

Back

1. Follow instructions on the other side

Gateway 2000 Portables!



color, brightness and clarity. You'll also find that the 10.4-inch screen has 23 percent more viewing area than a 9.4-inch screen, allowing you to see more spreadsheet cells, full word processing documents, and giving you the ability to read small fonts better.

The Gateway Liberty adds even more mobility with its infrared (IR) technology. Using wireless file transfer, you can transfer files between your Liberty and desktop (or between two Liberty PCs!) without cables. IR is also important for tomorrow's portable computing needs. Windows™ 95 was engineered with IR in mind, and IR-ready printers will be available soon.

Not enough battery life and suddenly your portable PC isn't much help! Nickel metal-hydrate batteries (NiMH) on the Liberty

will give you the best performance. You'll get up to four hours or more with power management. The Liberty was also designed to be upgradable to lithium ion batteries.

The value of your Gateway portable PC goes up, up, up with pre-installed software applications. All Gateway portable PCs include Microsoft® Works for Windows™ 3.0 or MS Office Professional 4.3 pre-installed. You also get the OAG® FlightDisk,^{us} World Clock, and Ascend® software applications.

Looking for ways to make your getaways more productive? Call a Gateway 2000 portable sales representative today!

Gateway 2000® Family PC™ Systems

4DX2-66 FAMILY PC

- Intel® 66MHz 486DX2 CPU*
- 8MB RAM
- 540MB 11ms IDE Hard Drive
- PCI Enhanced IDE Interface
- PCI Local Bus Graphics with 1MB
- 4X CD-ROM, 16-Bit Sound Card & Altec™ ACS-5 Speakers
- TelePath™ IIv 14.4K Fax/Modem Communication Center
- 3.5" Diskette Drive
- 14" .28 CrystalScan® Color Monitor
- 7-Bay Desktop Case
- 101-Key Keyboard & MS Mouse 2.0
- MS-DOS® 6.22 & WFW 3.11
- Generations Software Collection
- 3-Year Limited Parts Warranty

\$1699

P5-75 FAMILY PC

- Intel 75MHz Pentium® Processor*
- 8MB EDO Performance-Enhanced Memory
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X CD-ROM, 16-Bit Sound Card & Altec ACS-5 Speakers
- TelePath IIv 14.4K Fax/Modem Communication Center
- 3.5" Diskette Drive
- 15" .25dp Vivitron™ Color Monitor
- 7-Bay Desktop Case
- 101-Key Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- Generations Software Collection
- 3-Year Limited Parts Warranty

\$2199

P5-100 FAMILY PC

- Intel 100MHz Pentium Processor*
- 8MB EDO Performance-Enhanced Memory
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X 3-CD Changer, 16-Bit Sound Card & Altec ACS-5 Speakers
- TelePath IIv 14.4K Fax/Modem Communication Center
- 3.5" Diskette Drive
- 17" .26dp Vivitron Color Monitor
- 7-Bay Desktop Case
- AnyKey® Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- Generations Software Collection
- 3-Year Limited Parts Warranty

\$2899



SOFTWARE COLLECTION

- Microsoft® Encarta™ '95 • MS Bob™ • MS Money 3.0 • MS Works 3.0 • MS Publisher 2.0 • MS Publisher Design Pack • MS Cinemania® '95 • MS Bookshelf® • MS Composer Collection: Beethoven, Mozart and Schubert • MS Wine • MS Arcade: Missile Command™, Asteroids, Tempest™, Centipede® and Battlezone™ • MS Dinosaurs • Mayo Clinic® Family Health Book • Mayo Clinic Family Pharmacist • plus 31 popular MS entertainment games.

Professional Systems

4DX2-66

- Intel 66MHz 486DX2 CPU*
- 8MB RAM
- 540MB 11ms IDE Hard Drive
- PCI Enhanced IDE Interface
- PCI Local Bus Graphics with 1MB
- 2X CD-ROM
- 3.5" Diskette Drive
- 14" .28 CrystalScan Color Monitor
- 7-Bay Desktop Case
- 101-Key Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Works 3.0 & Money 3.0
- 3-Year Limited Parts Warranty

\$1449

P5-75

- Intel 75MHz Pentium Processor*
- 8MB EDO Performance-Enhanced Memory
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 32-Bit PCI Graphics Accelerator w/ 1MB DRAM
- 4X CD-ROM
- 3.5" Diskette Drive
- 15" .25dp Vivitron Color Monitor
- 7-Bay Desktop Case
- 101-Key Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf® & Money 3.0
- 3-Year Limited Parts Warranty

P5-75 \$1999

P5-90 \$2199

(90MHz Pentium processor, 730MB HD, 8MB RAM, 256KB cache)

P5-100 BEST BUY

- Intel 100MHz Pentium Processor*
- 8MB EDO Performance-Enhanced Memory
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X 3-CD Changer
- 3.5" Diskette Drive
- 15" .25dp Vivitron Color Monitor
- 7-Bay Desktop Case
- AnyKey Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf & Money 3.0
- 3-Year Limited Parts Warranty

\$2499

P5-120 BEST BUY

- Intel 120MHz Pentium Processor*
- 16MB EDO Performance-Enhanced Memory
- 256KB Pipelined Burst Cache
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X CD-ROM
- 3.5" Diskette Drive
- 15" .25dp Vivitron Color Monitor
- 7-Bay Desktop Case
- AnyKey Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf & Money 3.0
- 3-Year Limited Parts Warranty

\$2999

P5-133XL

- Intel 133MHz Pentium Processor*
- 16MB EDO Performance-Enhanced Memory
- 256KB Pipelined Burst Cache
- 1.62GB 10ms IDE Hard Drive w/ Mode 4 Support
- PCI Enhanced IDE Interface
- ATI Mach 64 Graphics Accelerator with 2MB VRAM
- 4X 3-CD Changer
- 16-Bit Ensoniq® Wavetable & Altec ACS-31 Speakers w/ Subwoofer
- TelePath IIv 28.8 Fax/Modem Communication Center
- 3.5" Diskette Drive
- 17" .26dp Vivitron Color Monitor
- 9-Bay Tower Case
- AnyKey Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf & Money 3.0
- 3-Year Limited Parts Warranty

\$4399

If you can't find a system that suits your needs, call us and we'll be happy to custom build one for you.

****MS Office Professional 4.3 includes MS Word, Excel, PowerPoint® presentation graphics program, and Access® database.**



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ALL THE GATEWAY GOODS!

Incredible values from Gateway 2000® Peripherals and software sold only with the purchase of a system.

Communications & Storage

TelePath™ 28.8 Fax/Modem Communication Center

Revolutionize your communication needs with the TelePath 28.8 fax/modem Communication Center. Internal fax/modem, 28,800bps modem, V.34, with 14,400bps fax capability. Sends and receives both faxes and voice messages. Includes a CompuServe® trial membership. **\$149** (TelePath™ II-14.4K Fax/Modem \$79)

Colorado Memory Systems® Jumbo™ 1400 TBU

CMS Jumbo 1400 internal tape backup unit with up to 1.36GB compressed (680MB native) storage capacity per tape. Comes with MS Windows™ and DOS® software, one tape and cable. **\$199**

Multimedia

New 4X Three-CD Changer

Enhance the value and usefulness of your PC with the 4X three-CD changer. It supports multisession photo CDs and XA format, enabling simultaneous audio and data with additional hardware. You'll have access to three times the amount of information of a regular CD-ROM drive and the ability to switch between programs. **\$100** (upgrade from 4X CD-ROM)

Audio Multimedia Kit

Here's everything you need to add multimedia to a Gateway PC.

- Gateway 2000 16-bit CD-quality sound card, compatible with Sound Blaster™ cards, with MIDI/game port, mic in, stereo line in/out
 - 2 Altec™ Lansing ACS-5 speakers
- \$99** (with system purchase)

Wavetable Audio Multimedia Kit

Once you've heard wavetable audio, basic audio will never do!

- Ensoniq® Soundscape™ 16-bit wavetable sound card, MT-32 and FM mode compatible. Supports most software for popular sound cards and standards including General MIDI, Sound Blaster, AdLib, Roland MPU 401, MS Windows Sound System and MT 32
 - New Altec Lansing ACS-31 three-piece speaker system
 - Blue Ribbon Sound Works® SuperJAM! jr. software
- \$209** (with system purchase)
\$110 (upgrade from systems with 16-bit sound card and Altec speakers)

Networking

3Com® Ethernet Adapters

High-performance 16-bit Ethernet cards.

16-bit Triple Media Card supports BNC, AUI and Twisted Pair media **\$109**
16-bit Twisted Pair Card **\$89**

SMC® PCI Ethernet Adapter

Supports both Twisted Pair and BNC Media **\$149**

National Semiconductor Ethernet Adapters

Informover™ brand NE2000plus™ Ethernet cards
Triple Media Card w/ 25-foot coax cable **\$89**
Twisted Pair only Card **\$69**

Call the Gateway 2000 special component add-ons division at 800-846-2080 for our complete line of extras for Gateway customers.
Sales hours: 7am-10pm Weekdays.

Software

Kid's Backpack™

Seven exciting software applications specifically for kids with Sesame Street® Numbers; My First Incredible, Amazing Dictionary; The Cat Came Back; The Yukon Trail™; Keroppi Day Hopper; Math Blaster®; In Search of Spot; and Sing-Along Kids™. Also includes a 20-disc storage rack and microphone. **\$99**

Flight Pack

Seven top-of-the-line flight CDs. Includes TFX™: Tactical Fighter Experiment, Aces Over Europe, Maximum Comanche®, Strike Commander, Privateer, Wing Commander™ Armada; and Warplanes. You also get a joystick and 20-disc storage rack. **\$99**

Sports Pack

Six action-packed sports applications. Includes Unnecessary Roughness '95™; Hardball 4™; FIFA International Soccer; PGA Tour® Golf; NHL® Hockey '95; and NASCAR® Racing. Also includes Gravis GamePad™ and CD holder. **\$99**

Monitors

Gateway 17-Inch Vivitron™ Color Monitor

Non-interlaced color monitor using Sony® Trinitron® tube technology, capable of 1280 x 1024 resolution in non-interlaced mode, .26 dot pitch. Upgrade from a 14-inch CrystalScan® 1024NI monitor **\$360**
Upgrade from a 15-inch Vivitron monitor **\$260**
(Upgrade prices good only at the time of system purchase.)

Printers

Hewlett-Packard 4L LaserJet Printer

A full-featured 300dpi printer loaded with enhanced PCL 5 and 26 scalable typefaces with 1MB standard HP Memory Enhancement Technology. Includes parallel cable. **\$559**

Epson® Stylus™ Color Ink Jet Printer

Features 360dpi high-quality print resolution and 720dpi for more brilliant colors on specially coated paper. Exclusive technology produces a precise dot. Includes parallel cable. **\$529**

Hewlett-Packard Deskjet 540 Inkjet Printer

Features clear, sharp 600 x 300dpi black printing on plain paper with a variety of built-in typefaces. Color option also available. Includes parallel cables. **\$299** (w/out color) **\$339** (w/ color)
Call for other printer options.



Gateway accepts most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers. You can also apply for the Gateway 2000 DuoLine™ MasterCard® card, issued by Dial National Bank, Des Moines, Iowa.



8 0 0 - 8 4 6 - 2 0 6 3

The
PERFECT

VALUE NOTEBOOK

The perfect value notebook strikes a compromise, balancing performance, features, and portability with an affordable price. **Price: \$2,700.**

10.4-inch dual-scan passive-matrix color screen

Dual-scan passive-matrix screens offer much of the vibrancy of expensive active-matrix panels, although their response times and viewing angles aren't as

impressive. Screens that measure 9.5 inches are acceptable. Avoid monochrome displays

• DX4/75 CPU

• 8MB of RAM

PCMCIA slots

Look for stacked slots that can accommodate two Type II cards or one Type III card

Full-size keys

Look for full-size keys with full 19-mm interkey spacing, so you won't have to adapt your touch-typing style.

Integrated pointing device

Choose whichever pointing device—pointing stick, touch pad, trackball, or miniature mouse—you're most comfortable with

• Removable 540MB hard disk

External AC adapter

Consider a spare (\$50 to \$100), so you can have one at the office and one at home

Nickel hydride battery

Nickel hydride cells offer longer lives than their nickel cadmium counterparts, though they can't rival the lives of lithium-ion batteries

Removable floppy disk drive

More and more notebooks let you swap out the floppy disk drive and replace it with a second battery.

Full-size serial, parallel, VGA, and keyboard/mouse ports

Make sure the notebook lets you plug into standard devices without proprietary port adapters.

• Docking-station connector

Integrated 14.4-Kbps modem

Avoid ungainly dongles and the hassles of PCMCIA configuration by getting a notebook with a V.32bis fax modem and RJ-11 jack built in. (Only a handful of products have this feature.)

DOCKING STATION

If your notebook PC is your only PC but you're dissatisfied with its cramped keyboard and display, or if you want access to features like a CD-ROM drive when you're at your desk, a docking station is the way to go. **Price, including a CD-ROM drive: \$700.**

ISA and PCI slots

Full-size expansion slots let you connect specialty cards—such as video-capture boards—or network cards.

Speakers

The docking station should include 2- to 5-watt speakers to provide better sound than the tiny speakers built into the notebook itself.

Expansion slots

Look for at least one bank of stacked slots that support two Type II cards or one Type III card.

Battery bay

Recharge a spare battery while you're charging the notebook itself. A few docking stations can operate under battery power alone, a solution that's suitable if you need portable multimedia capabilities only rarely.

Drive bay

If you need multimedia in the office but not on the road, get a docking station with a CD-ROM drive built in, or at least a 5.25-inch bay where you can add one later.

PORT REPLICATOR

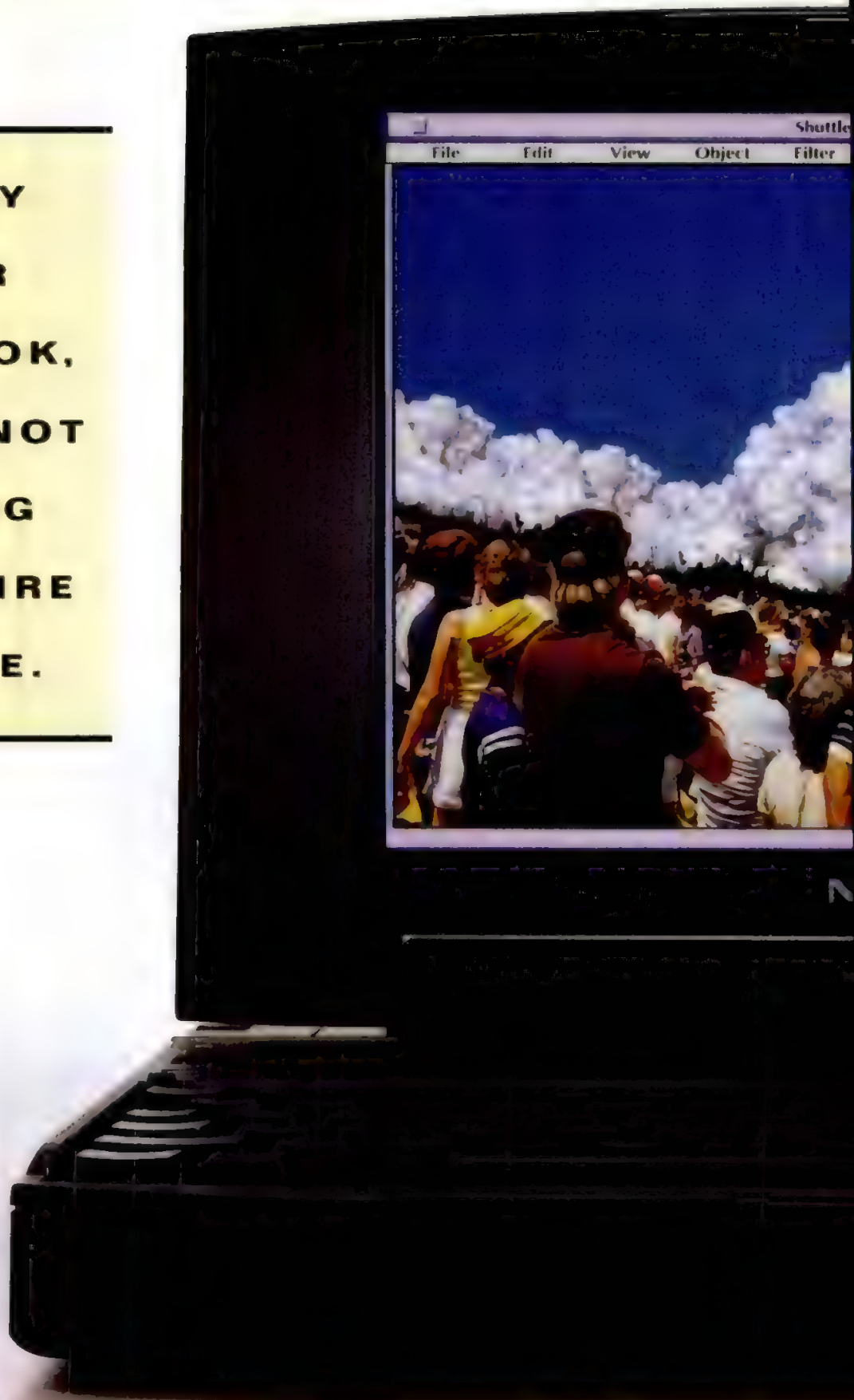
The port replicator is a low-cost solution that alleviates the hassle of plugging in a monitor, an external keyboard, and a mouse every time you get back to your desk. **Price: \$100.**

Ports

As a minimum, the port replicator should provide pass-through serial, parallel, keyboard, mouse, and VGA ports. A power plug can be helpful, too. The best solutions allow warm or hot docking.



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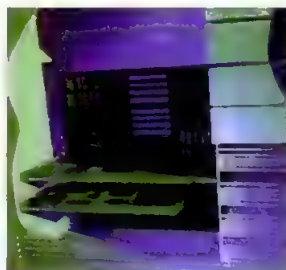
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WORKGROUP FILE SERVER

The workgroup server is a scaled-down version of the departmental server shown below. With slightly less memory (32MB or 64MB) and disk capacity (about 2GB, mirrored) and a single NIC, it's right for a dozen users.

Price: \$7,500 to \$10,000.

90- or 160-MHz Pentium CPU

File servers aren't usually constrained by processor speed. For most, a Pentium of any speed will suffice.

250- to 300-watt power supply

Consider an optional second power supply to provide a measure of fault tolerance.

CD-ROM drive

The CD-ROM drive exists more to simplify software installation than to provide shared access to CD-ROM data, a goal best achieved with an external CD jukebox.

Lockable front panel

Prevent tampering by means of a lockable front panel that covers removable media drives and the power button.

Internal fax modem

A modem lets server management software with remote-notification capabilities page you in case a problem arises.

Quad Ethernet PCI NIC

Rather than using up all your slots with four discrete network interface cards, use a quad Ethernet NIC that drives four segments from a single card.

EISA/PCI bus

EISA has long been the de facto standard expansion bus in servers, but PCI is catching on fast and will ultimately supersede EISA in 1996. For now, you'll want both: PCI for high performance, EISA for compatibility. To get more than three or four PCI slots requires multiple PCI buses: Dual designs are best, but bridged designs also make sense.

128MB of RAM

Servers are hungry for memory. The more you have, the more data the NOS can cache, ensuring top-flight performance.

1,000- to 1,500-wa UPS

An uninterruptible power supply is a must. Get one with a volt-ampere (va) rating that is about one-third greater than the combined wattage of the server and CRT as a minimum; larger capacities will give you a longer runtime.

Monitor

You don't need a color monitor, but out-of-bounds conditions and warnings show up better when they're in a special color.

DAT backup unit

Digital audio tape combines performance and reliability with high capacity (up to 8GB). Try a six-tape DAT changer to back up multiple servers.

Four 2GB Fast/Wide SCSI-2 hard disks

For a network of a few dozen users, 4GB of space is about right (although bigger disks are readily available to provide even more capacity). When it's mirrored for data integrity, this means buying a total of 8GB. Fast/Wide SCSI-2 offers 20-Mbps throughput.

Eight to ten drive bays

The server should have ample room for additional internal devices. Eight bays are enough for a floppy disk drive, a CD-ROM drive, a tape-backup unit, and four hard disks—with one bay to spare.



The
PERFECT

APPLICATION SERVER

The application server supports mission-critical database applications and demands high performance plus bulletproof fault tolerance. **Price: \$40,000.**



Monitor

High resolution is not crucial

3.5-inch floppy disk drive

1,000- to 1,500-wa UPS

If your server shuts down unexpectedly, it spells disaster for your data. An uninterruptible power supply (UPS) is a must. You'll need

one with a volt-ampere rating that is at least a third larger than the combined wattage of the server and CRT, and bigger is better

Redundant 300-watt power supplies

Since even a UPS can't guard against the failure of a power supply inside the machine, a redundant power supply provides a needed line of defense

Two or four 133-MHz Pentium CPUs

Application servers place high demands on CPUs and, under most operating systems, can benefit from multiprocessing

Quad Ethernet PCI NIC

Rather than use multiple discrete network interface cards (NICs), try a quad Ethernet NIC, which drives four segments from a single card

Dual PCI buses

A dual-PCI design lets the server avoid the three- to four-expansion-card limit of a single PCI bus without imposing any delays in data transfers. A bridged-PCI design is also acceptable—and more readily available

EISA bus

EISA lets you support a wide range of server-specific expansion cards, including high-end SCSI RAID controllers. It will fade in importance in 1996 as PCI takes hold.

Eight to ten drive bays

Application servers often rely on external disk arrays for their mass-storage needs, but ample internal space lets you keep your options open.

256MB of ECC RAM

Error checking and correcting RAM doesn't just detect single-bit memory errors; it corrects them—a crucial capability in a mission-critical server.

8GB RAID Level 5 subsystem

A RAID controller provides data redundancy and, in conjunction with the right hardware, lets you hot-swap failed hard disks without downing the server. An 8GB capacity requires five 2GB hard disks

Lockable front panel

Prevent tampering by means of a locking front panel that covers removable-media drives and the power button

DAT backup unit

Digital audio tape (4-mm) combines high performance with high capacity—up to 8GB

CD-ROM drive

An internal CD-ROM drive helps simplify software installation. To provide access to shared CD-ROM data, add an external CD jukebox

Inside the Perfect System Unit

The Perfect PC is more than a haphazard combination of the ideal processor, display, hard disk, and multimedia components. It's also the factors that make your PC easy to use and leave room to grow.

By John Clyman

Whether you're planning to buy a bare-bones entry-level system or a fully loaded dream machine, there's a host of features that you shouldn't overlook. Some are electronic, such as a Plug and Play (PnP) BIOS (basic input/output system) that promises to simplify hardware upgrades. Others are mechanical, such as tool-free enclosures that let you get inside your PC's case without a screwdriver. And, of course, you'll want to make sure you choose the right components.

Taking the time to specify a properly outfitted machine today is a means of preserving your investment tomorrow. Though the features of the perfect system unit will vary depending on your tastes, needs, and computing experience, we've compiled this compendium of a handful that we think are particularly important.

THE PERFECT CASE

When you think about buying a car, you probably have a basic chassis design—two-door hatchback, four-door sedan, minivan—in mind before you settle on specifics such as manufacturer or model. You'll look for a body design that fits your current lifestyle; you're not likely to buy a minivan, for example, if you don't have kids to haul around. The *form factor*, or physical dimensions, of your PC can be an equally important consideration, because this will ultimately determine how your PC will fit into your working environment and how much expandability it will offer.

Traditionally, PCs occupied one of two positions: They sat atop the desk and beneath the monitor, or they stood on the floor beneath the desk, often as a space-saving measure. Those two basic form factors—the *desktop* and the *tower*—have since diversified into five uniquely identi-

fiable chassis designs (see the diagram). *Slimline* models retain the desktop *footprint* (a measure of the horizontal desk space they occupy) but are compressed vertically. This means they offer fewer available drive bays for mass-storage devices such as hard disks and CD-ROM drives. It also means they're not tall enough to accommodate standard expansion cards and instead employ a *riser card* that stands perpendicular to the motherboard, with expansion cards plugged in sideways. Riser cards usually offer two to three expansion slots rather than the six to eight provided in standard desktop cases; this won't be a problem so long as the system manufacturer integrates enough basic components such as graphics and disk controllers, onto the motherboard.

With the high level of integration in today's systems, floor-standing tower cases are really more appropriate for servers than for individual users; it's hard to imagine filling the eight to ten drive bays that many full-size tower cases offer. An increasingly popular alternative to the full-height tower case is a *mini-tower* design, which stands vertically but at 15 inches is short enough that it can sit atop a desk without being obtrusive. We're quite fond of mini-towers because they offer ample expansion and since they don't sit beneath the monitor, they also don't lift the monitor to a height at which viewing can be uncomfortable. You can flip many desktop cases on their side and use them in a mini-tower configuration, as long as the CD-ROM drive has clasps to ensure that a disk won't slip out.

The fifth case design you're likely to run across, particularly in consumer-oriented PCs, is the *all-in-one* design, sometimes referred to as a *monoputer*. This design offers minimal expansion and limits

System-Case Designs: A Comparison

How much expandability do you need? Make your decisions on a case-by-case basis.

Case type	All-in-one	Slimline	Desktop	Mini-tower	Tower
Slots	2 or 3	2 to 4	6 to 8	6 to 8	8
External drive bays	2 or 3	2 or 3	3 or 4	3 or 4	4 to 6
Internal drive bays	1 or 2	1 or 2	2 or 3	2 or 3	4 to 6
Pros	Occupies little space; speakers may be integrated	Low profile; highly integrated components	Moderate expandability; can be flipped on its side for towerlike use	Small footprint; ample expandability for the typical user	Massive expandability; stands on floor
Cons	Limited expandability; difficult to service; typically only a 14-inch monitor	Limited expandability	May lift the monitor to an uncomfortable height	Interior often cramped	Overkill for most users; may not fit under a desk

The PERFECT SYSTEM UNIT

It pays to be choosy about little details that can make your system easier to use and maintain in the long run. Here are a few features you should look for in any machine, plus some of the design touches that help set an extraordinary system apart from an average one. **Price: \$1,500 to \$5,000.**

Backup solution

Whether you choose a tape-backup unit—digital audio tape (DAT) for large disks, Travan for disks up to 1GB—or a network software agent that works in tandem with your server, defining a backup strategy for your critical data is essential

Recessed reset button

Reduce the chance you'll carelessly destroy a day's work with a recessed reset button that can't be pressed accidentally—crucial on home machines for families with inquisitive youngsters

Infrared port

Tired of plugging in cables to interchange files with your notebook? An IrDA-compliant infrared port promises to make file transfers simple point-and-shoot, 115.2-kilobit-per-second operations.

Suspend/security button

Thwart prying eyes and save power with a suspend button that requires a password before it reactivates the PC

Moderate expandability

You don't need a hulking full-size tower to have plenty of space to grow. Look for a mini-tower case with one or two available drive bays and five or six unoccupied expansion slots

PCI and ISA slots

PCI has displaced VL-Bus as the high-speed expansion bus of choice; you'll still need ISA for compatibility

Plug and Play BIOS

A flash BIOS lets you upgrade your system's low-level interface firmware to fix bugs or handle unanticipated hardware requirements. A Plug and Play BIOS adds the ability to detect motherboard devices and their resource usage to simplify hardware upgrades

Dual-channel Enhanced IDE interface

Enhanced IDE is inexpensive, easy to use, and fast—preferable to SCSI in virtually all desktop environments. It removes IDE's 528MB capacity limit and supports the ATAPI standard, which lets you connect devices such as CD-ROM drives. A dual-channel interface supports up to four devices—two fast, two slow

Easy-access case

Reduce maintenance headaches by looking for a system with thumbscrews or clasps, so you don't have to use a screwdriver to get under the hood

High-speed parallel and serial ports

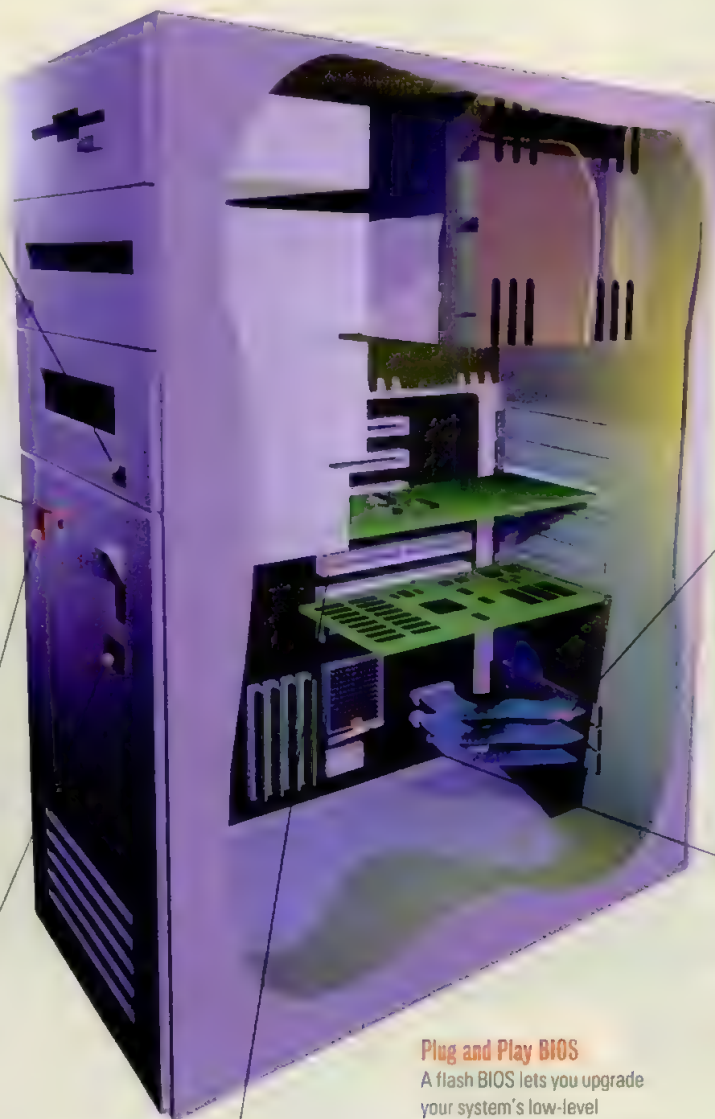
Parallel ports that comply with the ECP (Extended Capabilities Port) and EPP (Enhanced Parallel Port) standards support bidirectional communication and a 1-megabit-per-second data rate—about ten times that of standard Centronics implementations. Serial ports should use 16550 UARTs to handle fast external modems easily

ZIF socket

Make processor upgrades painless with a zero insertion force socket. Just flip a small lever to release the CPU; press the lever down to lock the new processor in place

DMI compliance

With a BIOS and peripherals that support the Desktop Management Interface standard, network administrators can remotely check on your system to keep an accurate inventory and, in some cases, detect problems before they become critical.



THE PERFECT PC

The Perfect System Unit

you to the specific monitor (usually a 14-inch model) that the manufacturer built in; it's most appropriate in environments where space is at a premium, such as a college dorm room or the kitchen.

DESIGN DETAILS

In any of these case designs, you'll want to look for time-saving features such as thumbscrews to anchor the machine's cover, so you don't need a screwdriver to get inside the box. You should also examine the ergonomics of the case itself: For instance, some manufacturers recess the front-panel reset button to reduce the chance of inadvertently restarting your system. On the back side of the case, look for a monitor power plug, so you can

power-down your system without having to turn off the monitor separately.

Inside the case, you'll want to make sure you have easy access to the hard disk, memory, and other components you might want to upgrade or replace. Space can be particularly limited inside slimline cases; to make access easier, a number of manufacturers provide hinged case designs that let you swivel a portion of the PC's internals out of the way, giving you clear access to the motherboard.

Design touches take on a whole new level of importance in home-oriented systems, which are often targeted at novice users who don't have a resident computer expert to help them wrestle with installation. Clearly labeled—or even color-

coded—device connectors are a plus. So are quick-installation posters or guidebooks and installation videotapes.

Incidentally, any PC you use at home must meet the Federal Communications Commission's Class B standards for electromagnetic radiation to ensure that the unit won't scramble TV or radio reception in residential environments. In general, we think FCC Class B compliance is worth looking for even in business PCs—it shows an additional level of engineering quality control and attention to detail on the part of the manufacturer.

SECURING YOUR INVESTMENT

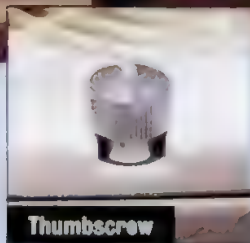
Whether your PC resides in the home or in the office, security features let you keep

The Perfect Finishing Touches

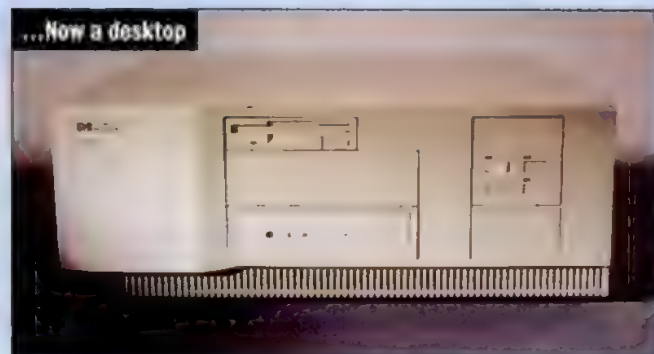
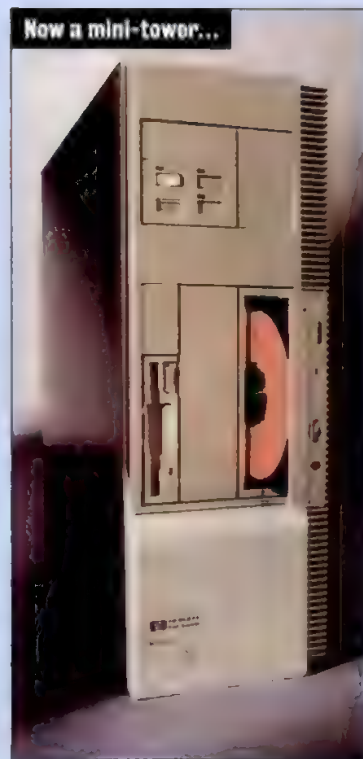
Little things can make a big difference. Here are some of the features that distinguish exceptionally designed system units from pedestrian ones.



▲ The Compaq Presario CDS 520 eliminates the rat's nest of cables that often characterizes a multimedia PC. A cradle for the monitor offers built-in speakers (with a handy instant-mute button) and a convenient headphone jack. On the back side of the machine's case, large thumbscrews make getting inside the system unit a snap.



► If you want a single PC that can serve as both a desktop and a mini-tower, the HP Vectra XU 5/90C fills the bill. This desktop system is also designed to stand on its side: Front-panel indicators even rotate so that labels and buttons remain right side up. And the spindle on the caddyless CD-ROM drive is designed to secure CDs in place even when the drive is standing vertically.



THE PERFECT PC

The Perfect System Unit

prying eyes away from sensitive data and grabbing hands away from expensive hardware. Basic preventive measures include a power-on password; the best solutions allow two separate passwords, one for the individual user and one for the system administrator (so the company can still access locally stored files in case the user is taken ill or leaves the company on bad terms). A step beyond is a front-panel "coffee-break" button (or keyboard sequence) that puts the PC into an energy-saving slumber mode, requiring a password upon wakeup. A similar solution is one that puts the PC into a secure, power-saving mode after a specified period of keyboard and mouse inactivity.

Some machines let administrators dis-

able particular components in the system—typically, parallel ports, serial ports, or floppy disk drives. The floppy disk drive can often either be shut off altogether or can be bypassed during the boot sequence, which still lets users read and write data while ensuring that the system starts up from the hard disk as intended.

More extreme measures for ensuring data security are available as well. Third-party utilities let you encrypt data on your hard disk; if you're particularly sensitive to snoopers, you might consider slide-out removable hard disks that you can lock away in a desk drawer or safe. A case that locks shut will prevent all but the most determined thieves from getting inside your system. And to keep the system from

being stolen outright, some manufacturers build in a security loop or slot for a Kensington lock, which lets you strap the PC to a desk with a cable.

MOTHERBOARD COMPONENTS

Undoubtedly, you'd like to know which components you'll need inside the machine to ensure it won't be obsolete instantly. The reality is that avoiding obsolescence in PCs is an insuperable struggle: The frenzied pace of innovation means that the fastest machine you can buy today will be at the bottom of the chain in two years, and there's really nothing you can do about it. Just two years ago, for instance, the 486DX2/66 stood at the pinnacle of the power curve; now, with Intel's increasing emphasis on the Pentium processor family, a 486DX2/66 barely maintains a toehold among entry-level systems.

Creeping obsolescence implies that a faster CPU is always better, right? If you have unlimited funds, sure. But if you're working under a budget, it's more important to make sure you select a *balanced* set of components. A fast CPU is next to worthless if it's hamstrung by insufficient memory or a slow hard disk. In fact, you're better off making the move from 8MB to 16MB of system RAM than you are upgrading from, say, a Pentium/75 to a Pentium/90. Similarly important is sufficient L2 processor cache. (See the sidebar "Optimizing Performance: What It Takes.")

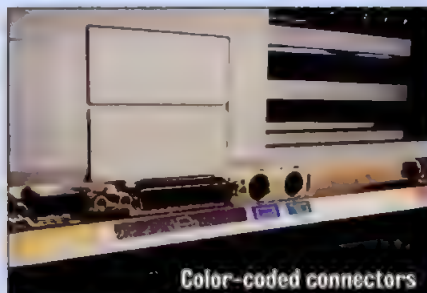
Still, you don't want to buy a CPU that's underpowered for your needs. Today, we think your best bet is a Pentium-class processor; by the end of the year, 486s will be shipping in new PCs only at rock-bottom (\$999) price points. For a list of comparative processor specs, see the sidebar "A Proliferation of Processors."

You might be tempted to rationalize the purchase of a slower CPU with the promise that you'll upgrade in the future using a product such as Intel's OverDrive chip. We're not fond of processor upgrades for a couple of reasons. One is that, by the time you're ready to upgrade, you're likely to discover that it's not just your CPU that's behind the times: Your hard disk, graphics adapter, and RAM may be inadequate as well. Furthermore, the price of the CPU upgrade, anywhere from \$250 to nearly \$1,000, may not justi-

▶ Infrared data transfer is the wave of the not-too-distant future: By year-end, you'll be able to transfer files easily between notebooks and desktops without cumbersome cables. The Austin Power Plus 100 incorporates an IrDA (Infrared Data Association)-compliant port on its front panel, along with audio jacks.



▲ Machines like this Micron P120 Millennia, with its partially recessed reset button, make it tougher to reset your system inadvertently. The P120 also offers a monitor plug so you don't have to switch power off separately.



▲ If you're tired of deciphering the cryptic icons that tell you whether a back-panel port is for a mouse or a printer, Packard Bell offers an unambiguous solution: color-coded ports and cables that make matching a cinch.



◀ CD changers for stereos are nothing new, but Gateway 2000 was the first to incorporate a three-CD changer into a desktop system. The Gateway P5-133XL lets you keep three CDs loaded at once. Also appealing: Some Packard Bell models incorporate two standard CD-ROM drives and utilities that let you run software off either drive.

An ordinary PC?

With a PC, people are confined to
working alone. They can work:

On the same document
(but not at the same time).

By e-mail (but not through their pager).

On the road (but good luck getting
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A Proliferation of Processors

By John Clyman

Intel isn't the only x86-processor vendor in town, and many PC vendors are turning to alternative sources to provide CPUs for many of their systems. Compaq's Presario line of consumer PCs, for example, includes models with AMD 486SX2 chips and ones with NexGen Nx586 processors. The table below shows how various x86 CPUs differ; here's what some of the terms mean.

CPU clock speed is a relative indicator of performance within a given processor family, although design differences mean that not all identically clocked CPUs are equal. (In fact, NexGen names its processors not by their true clock speeds but by estimating what the clock speed of a comparably performing Pentium would be.) **Memory-bus speed** indicates the speed

at which the processor communicates with L2 cache and memory; for clock-doubled CPUs such as the 486DX2, this will be half the CPU clock speed. **Expansion-bus speed** indicates how fast a PCI bus (or a VL-Bus) runs in a PC with a given CPU. Note, for instance, that the PCI bus in a 75-MHz Pentium is, at 25 MHz, slower than that of a 60-MHz Pentium (30 MHz).

Supply voltage indicates the voltage at which the CPU operates; lower-voltage CPUs are better suited to portable applications and "green" PCs. **Address-bus width** is a measure of how much memory the CPU can access in total; a 32-bit bus supports a whopping 4 gigabytes (or 4,096MB) of RAM. The CPU reads from and writes to L2 cache in chunks specified by the **data-bus width**.

Most CPUs have a **built-in floating-point coprocessor**, which speeds specific types of numerical computations (although not ones that are frequently used in typical applications). A **superscalar** CPU can execute more than one instruction in each clock cycle, so it usually runs faster than a **scalar** (one instruction per clock cycle) processor. **L1 cache design** specifies the amount and structure of the processor's on-board cache. A large cache lets the CPU minimize time-consuming accesses to off-chip cache or main memory; **write-back** caches are capable of storing both reads and writes for maximum performance, whereas **write-through** designs store reads only.

By year-end, expect to see 150-MHz Pentiums, as well as Pentium competitors from AMD and Cyrix. □

Vital Statistics: x86 Processors

■ YES ■ NO

Processor	CPU clock speed (MHz)	Memory-bus speed (MHz)	Expansion-bus speed (MHz)	Supply voltage	Address and data-bus widths (bits)	Built-in floating-point coprocessor	Superscalar	L1 cache design
AMD 486SX2/66	66	33	33	3.0	32, 32	■	■	8K unified, write-back
AMD 486SX4/100	100	33	33	3.0	32, 32	■	■	8K unified, write-back
AMD 486DX2/80	80	40	40	3.0	32, 32	■	■	8K unified, write-back
AMD 486DX4/100	100	33	33	3.0	32, 32	■	■	8K or 16K unified, write-back
AMD 486DX4/120	120	40	40	3.0	32, 32	■	■	8K or 16K unified, write-back
Cyrix 486DX2/66	66	33	33	3.45 or 5.0	32, 32	■	■	8K unified, write-back
Cyrix 486DX2/80	80	40	40	3.45	32, 32	■	■	8K unified, write-back
Cyrix DX4/100	100	33	33	3.45	32, 32	■	■	8K unified, write-back
IBM 486DX2/66	66	33	33	3.3 or 3.45	32, 32	■	■	8K unified, write-back
IBM 486DX2/80	80	40	40	3.45	32, 32	■	■	8K unified, write-back
Intel 486SX2/50	50	25	25	5.0	32, 32	■	■	8K unified, write-through
Intel 486SX2/66	66	33	33	5.0	32, 32	■	■	8K unified, write-through
Intel 486DX2/50	50	25	25	5.0	32, 32	■	■	8K unified, write-through
Intel 486DX2/66	66	33	33	5.0	32, 32	■	■	8K unified, write-through
Intel DX4/75	75	25	25	3.3	32, 32	■	■	16K unified, write-back
Intel DX4/100	100	33 or 50	33 or 25	3.3	32, 32	■	■	16K unified, write-back
Intel Pentium/60	60	60	30	5.0	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/66	66	66	33	5.0	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/75	75	50	25	3.3 or 2.9	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/90	90	60	30	3.3 or 2.9	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/100	100	66	33	3.3	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/120	120	60	30	3.3	32, 64	■	■	8K code, 8K data, write-back
Intel Pentium/133	133	66	33	3.3	32, 64	■	■	8K code, 8K data, write-back
NexGen Nx586-P75	70	70, 35*	35	4.0	32, 64	Optional	■	16K code, 16K data, write-back
NexGen Nx586-P80	75	75, 37.5*	37.5	4.0	32, 64	Optional	■	16K code, 16K data, write-back
NexGen Nx586-P90	84	84, 42*	42	4.0	32, 64	Optional	■	16K code, 16K data, write-back
NexGen Nx586-P100	93	93, 46.5*	46.5	4.0	32, 64	Optional	■	16K code, 16K data, write-back

* The Nx586 CPU has two memory buses: one to L2 cache, which runs at full CPU speed, and a second bus to system memory, which runs at half the CPU's speed.



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Optimizing Performance: *What It Takes*

By John Clyman

Building a fast system isn't as simple as dropping in the speediest processor you can buy; memory and peripherals need to be up to speed, too. As the accompanying chart shows, the slowest Pentium/100 machine we've tested is easily outperformed by the average Pentium/75. That's an unmistakable sign that choosing the right components—and tuning them optimally—is crucial to maximizing performance.

What differentiates the machines that lead the pack? A combination of factors that begins with the processor-memory subsystem: the CPU itself (and its internal cache), external or L2 processor cache, and main-system memory. The design of the memory subsystem is critical because today's

which includes the time it takes the memory to get ready for the next access). All the processor speed in the world amounts to nothing if the CPU constantly has to wait for the data it needs to operate upon.

The mismatch between CPU and memory speeds is why system designers almost invariably employ processor cache, a small amount (often 256K) of very high-speed—and relatively expensive—static RAM (SRAM) as a sort of buffer between the processor and the memory. The cache stores information that the processor has requested recently, so when the same (or nearby) information is requested again, the CPU can retrieve it from the faster cache—often in just 20 ns or so—rather than waiting for main memory to catch up. (The

75- and 100-MHz Pentium systems, plus nearly all 120-MHz and faster Pentium PCs, supports a specialized type of synchronous cache known as *pipelined-burst* cache. But in the vast majority of today's system designs, we haven't found pipelined-burst cache to provide any performance benefit beyond that of standard synchronous burst cache.

Naturally, DRAM designers are working on ways to tweak more performance out of main memory as well, although the overriding prerogative is to keep cost reasonable. A solution that's catching on quickly is *EDO* (extended data out) DRAM, which effectively allows the processor to overlap the beginning of one memory access with the end of the previous one; individual memory accesses don't occur more quickly, but a series of memory accesses can be finished in less time than with standard fast-page-mode DRAMs.

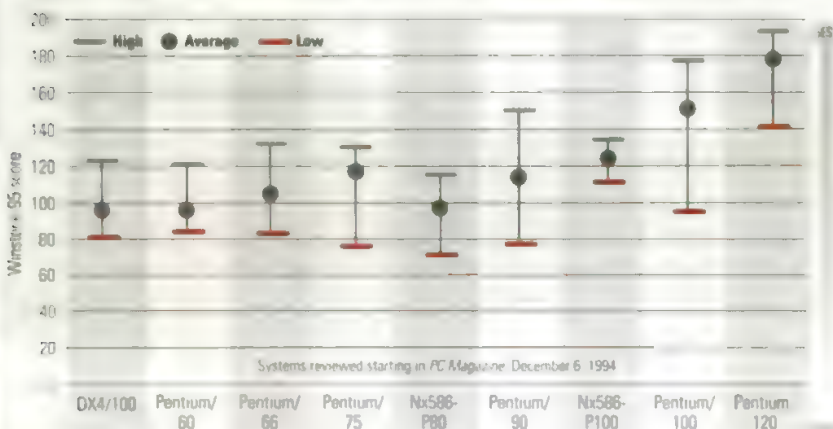
The beauty of EDO DRAM is that it requires a trivial alteration to existing DRAM designs and doesn't cost substantially more to manufacture. But EDO DRAM is just the first of many new system-memory technologies lurking on the horizon. Later this year, you can expect to see systems with still-faster synchronous DRAMs or even esoteric Rambus DRAMs—which use a 250-MHz clock speed to transfer large bursts of data extremely rapidly.

PERIPHERALS COUNT

Even a well-designed memory subsystem doesn't guarantee top performance if it's mated with a slow graphics controller or, even more important, a slow disk controller. An improvement of a few nanoseconds in the access time of the memory subsystem pales in comparison to the 10- to 15-millisecond access time of hard disks (a millisecond is 1,000 nanoseconds). Thus, it pays to keep as much data in system RAM as possible to avoid accessing the disk. Once again,

System Performance by CPU Type

Processor speed has a clear impact on overall system performance. The average Pentium/120 system is nearly twice the speed of the average DX4/100. But poor system design can hamstring even the fastest CPU. Notice that the slowest 75- and 90-MHz Pentium systems we've tested were easily eclipsed by many 60- and 66-MHz Pentiums, and even by DX4/100s. All tested systems had 16MB of RAM.



fastest CPUs operate far more rapidly than the dynamic RAM (DRAM) chips used for system memory; for instance, a 100-MHz CPU typically performs one or more operations every 10 nanoseconds (ns), while the fastest memory in widespread use is rated for 60-ns access time (and in fact often has a *cycle time* closer to 130 ns.

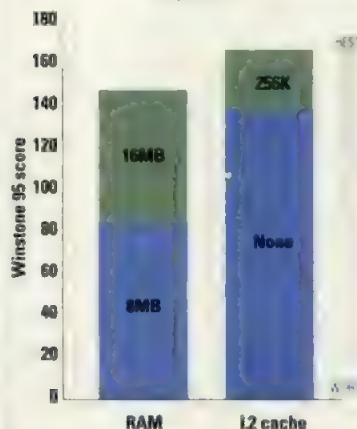
accompanying diagram shows how performance of machines based on a high-speed processor can suffer in the absence of L2 cache.)

Caches have typically employed *asynchronous* SRAMs, but newer *synchronous* SRAMs promise faster access times. Intel's Triton chip set, which is used on the motherboards of numerous

The Perfect System Unit

Memory: Don't Cut Any Corners

Doubling RAM from 8MB to 16MB nets a 75 percent performance improvement on a Pentium/100 system. Going from no cache at all to a 256K cache increases performance by 20 percent.



this means caching is important; in this case, it's caching frequently used disk sectors with a tool such as SmartDrive (included with DOS) or the more efficient 32-bit File Access in Microsoft Windows for Workgroups. The ability to use larger caches is a particularly compelling reason to choose a 16MB system rather than one with 8MB; you'll be able to cache more data (typically, 4MB instead of 2MB), and because there's more main memory, the operating system will swap data out to the disk less frequently. The chart above shows that an upgrade from 8MB to 16MB can provide a 75-percent performance boost to real applications running on a 100-MHz Pentium machine.

What if you increase memory further—to 32MB? We haven't found the additional RAM to confer any significant performance advantage on our Winstone 95 benchmark tests, which are based on best-selling applications under typical usage patterns. Where it does make a difference is in dealing with large data files like desktop publishing documents or full-color high-resolution images. □

fy the performance increase you derive.

Still, it's easy enough to ensure that the upgrade option is available should you choose to exercise it. Just make sure your motherboard has a ZIF (zero insertion force) socket, which makes replacing a processor a trouble-free operation.

What about motherboards that provide a second ZIF socket to support a second identical CPU and let you test the appeal of multiprocessing? Don't bother, unless you're in a highly compute-intensive business such as image editing or CAD—and you're willing to use a multiprocessing-aware operating system such as Microsoft Windows NT or OS/2 SMP.

One upgrade you *should* plan for is your system memory—particularly if you start out with only 8MB. When you buy your machine, make sure it comes with at least two open sockets for SIMMs (single in-line memory modules), small circuit boards on which memory chips are mounted. Most machines have from four to eight SIMM slots, but some manufacturers fill them all with low-capacity SIMMs. If you don't have any available SIMM sockets and you later decide to upgrade, you'll have to remove some of your existing memory to do so.

THE PERFECT EXPANSION BUS

Don't buy a PC today unless it offers a PCI (Peripheral Component Interconnect) high-speed expansion bus. Although you'll still want the traditional ISA (Industry Standard Architecture) bus for slower peripherals such as modems, PCI offers far higher performance. It's a 32-bit bus that runs at speeds from 25 MHz to 33 MHz, whereas ISA is a 16-bit bus that runs at about 8 MHz. You'll definitely want a PCI-based graphics accelerator, and PCI is necessary to support high-speed networking standards such as 100Base-T as well as capabilities such as digital video.

A number of manufacturers still build machines—particularly 486-based systems—that use the VESA local bus (or VL-Bus). VL-Bus offers many of the benefits of PCI but ultimately lost out to PCI in the marketplace. With manufacturers of both expansion cards and systems focusing on PCI, VL-Bus is a dead end.

Two more buses to avoid in desktop systems are EISA (Extended Industry Standard Architecture, a 32-bit extension

to the ISA bus) and Micro Channel (a proprietary IBM solution). Both of these buses are more appropriate for servers than for workstations.

Expansion cards—particularly ISA expansion cards—are notoriously difficult to configure properly. Designers are working on devices that comply with PnP standards that will eliminate many compatibility and configuration hassles. PnP cards are still few and far between, but it can't hurt to select PnP-enabled products if they're available. And you should definitely look for a PnP BIOS; the BIOS controls low-level hardware interactions, and a PnP-aware BIOS will ensure that motherboard components are properly identified to the operating system. PnP BIOSes require reprogrammable *flash* memory instead of the traditional ROM (read-only memory) used to store BIOS code.

PERIPHERAL CONTROLLERS

The perfect system unit should also have the latest in motherboard controllers to allow high-speed communication with mass-storage devices and external peripherals such as printers and modems.

Virtually all motherboards today offer built-in Enhanced IDE (integrated drive electronics) support, which extends basic IDE standards to support disk capacities beyond 528MB, up to four devices (instead of two), and additional devices such as CD-ROM drives. Look for dual-channel IDE support, which lets you hook up two devices to each of two channels: one high-speed (typically for hard disks), and one lower-speed (for CD-ROM drives and tape-backup units).

Your motherboard should also include 16550 UARTs (universal asynchronous receiver/transmitters), which control serial ports. The 16550 UART allows higher transfer rates than the older 8250 UART due to its 16-bit buffer—an important consideration as 14.4- and 28.8-kilobit-per-second modems become standard. Similarly, you should look for parallel ports that support the EPP (Enhanced Parallel Port) or ECP (Extended Capabilities Port) standards, which allow two-way or *bidirectional* communication between the PC and attached devices (usually a printer), plus ten times the transfer rate of the traditional Centronics parallel-port interface.

In Search of the Perfect Peripheral Bus

By John Clyman

The battle for the big bus is over: It's PCI over VL-Bus and EISA. At least, that's true for the system bus; there's also the matter of a secondary bus for connecting peripherals externally. A successful solution needs to combine relatively high performance, compatibility with a range of device types, support for automatic identification and configuration of attached peripherals, hot-plugability, and low implementation cost. And it needs to consolidate cables so that you've got fewer cords snaking around the PC.

The vendors backing the two leading contenders hint at the magnitude of the debate: On one side are Apple Computer Corp. and consumer-electronics vendors with the IEEE 1394 specification (which Apple calls "FireWire"); on another are Intel Corp., Microsoft Corp., and major PC vendors with the Universal Serial Bus (USB) specification. A third choice is Access.bus, promoted mostly by monitor vendors.

UNIVERSAL SERIAL BUS

Universal Serial Bus is the solution that's likely to have the most impact on the x86-compatible PC marketplace; although widespread support from peripheral manufacturers is a year away, you'll see system vendors begin to support USB late this year. In fact, Intel can—and probably will—make USB a no-brainer addition for PC manufacturers. We expect Intel to integrate USB functionality into its core-logic chip sets, which are used by dozens of system vendors, and onto motherboards that Intel supplies by the carload.

USB aims to consolidate the func-

tions of separate keyboard, mouse, joystick, microphone, speaker, and serial ports that exist on a PC today, providing in their place a single standardized connector that works with nearly any device. USB relies on *hubs* that permit connection of multiple devices. In practice, the PC itself is

likely to act as a hub for printers, modems, and digital-phone connections, while the monitor acts as another hub for devices such as speakers and microphones and the keyboard serves as a third hub for the mouse and joystick. USB supports up to 64 connected devices and signals at a speed of 12 megabits per second (Mbps)—about as fast as a typical

Ethernet network link and marginally fast enough for peripherals such as CD-ROM drives.

IEEE 1394: FIREWIRE

The IEEE 1394 specification, implementations of which Apple has dubbed "FireWire," also addresses the peripheral-connection question. But FireWire is optimized more for performance and less for cost sensitivity. Like USB, FireWire supports a variety of device types, but its real appeal will be for applications such as digital video and digital photography.

FireWire supports data-transfer rates of 100, 200, or even 400 Mbps (or any combination of the above), and one of its key technical strengths is support for *isochronous*—in essence, real-time—data. Essentially, FireWire guarantees on-time delivery, a feature critical for ensuring proper synchronization between audio and video portions of a broadcast, for example.

At a design cost of roughly \$10 per device, FireWire is substantially more

expensive to implement than is USB. (The cost actually seems reasonable until you consider that it translates into \$40 to \$50 at the end-user level.) The cost, however, will be absorbed in some applications by the reduced expense of supporting hardware. For instance, traditional methods of handling digital video require an expensive video-capture board to convert analog NTSC-compatible signals (the North American television standard) to digital data usable by the PC. But with FireWire, that digital-to-analog translation is no longer needed.

FireWire supports up to 63 devices and is likely to appear first in Apple desktop PCs. Because of its high speed, it even has the potential eventually to supplant SCSI as a hard disk interface.

ACCESS.BUS

Access.bus, a joint development of Digital Equipment Corp. and Philips Electronics, aims to provide many of the same features as USB while encompassing the VESA DDC (display data channel) specification that permits two-way communication between a monitor and a graphics card. A handful of monitor vendors endorse Access.bus, but with companies such as Intel and Microsoft backing USB, the future of Access.bus looks bleak (although Access.bus and USB can coexist).

EMERGING BUS TECHNOLOGIES

Attempts to define new bus standards will continue as the PC industry further stresses ease of use. CardBus, a 32-bit, PCI-like successor to PCMCIA, aims to eliminate internal expansion cards altogether and make all PC upgrades possible through PCMCIA-like cards that snap in externally. Serial Storage Architecture (SSA) is a high-end solution for connecting large amounts of fault-resilient disk storage in servers. □

*Attempts to define
new bus standards,
such as USB and
FireWire, will
continue as the PC
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MASS STORAGE

Most desktop systems no longer need 5.25-inch floppy disk drives; if you need to read old disks, look for a so-called combo drive that combines 5.25- and 3.5-inch drives in a single drive bay.

It's impractical to back up today's gigabyte-capacity disks to a stack of 1.44MB floppy disks, so if your perfect system isn't going to be connected to the network, you'll want to explore a tape-backup solution.

If you frequently swap data with a laptop computer, you might want to consider a PCMCIA (Personal Computer Memory Card International Association) "drive" that lets you plug in a PC Card hard disk that you can also use in the notebook. An even better solution is to look for both a desktop and notebook with IrDA (Infrared Data Association) transceivers; much like a television remote control, IrDA ports let you transmit information without wires.

MANAGING YOUR CORPORATION'S PCs

The proliferation of networks has presented a problem for network administrators: how to account for and maintain all the hardware that's out there. PC manufacturers are beginning to incorporate DMI (Desktop Management Interface) support into their PCs, which allows the network administrator to monitor remotely—and in some cases even control—aspects of the PC's configuration. The extent of DMI support varies widely today: Minimal implementations simply report basic configuration data such as serial numbers and amount of RAM installed. More sophisticated solutions actually let the administrator lock out components and detect imminent hardware failures.

Large corporations may also be concerned about the combined power draw of installed PCs—and the additional cooling requirements that PCs generate. To reduce the expense of power and cooling, most PCs today support some form of power conservation, usually in a way that

complies with the Environmental Protection Agency's Energy Star program. The original Energy Star specs present a relatively low hurdle: They require only that a machine draw 30 watts or less when idle (the monitor is permitted to draw another 30 watts). Machines that comply can wear an Energy Star logo, and the federal government and some large corporations require Energy Star compliance on any machines they purchase.

In the fall of this year, the EPA is altering the Energy Star requirements slightly: Machines must ship with power-saving features enabled, and on-line documentation must be provided that describes how to use the features.

Another option to consider is an unin-

interruptible power supply (UPS), which can prevent you from losing data when power fails. Look for a UPS with a va (volt-ampere) rating about one-third larger than the combined wattage of your system unit and monitor. The UPS won't keep your PC running for hours, but it will support you for the few minutes it takes to save your open files and shut down gracefully. Low-capacity models suitable for desktop use cost only about \$100.

SERVICE AND SUPPORT

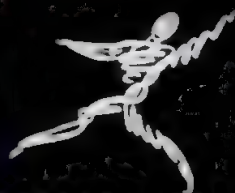
The perfect system unit wouldn't be complete without a perfect service-and-support package to back it up. We think three-year warranties with first-year on-site service are appropriate. And for many users, 24-hour, 7-day-a-week technical support will be important as well. We summarize vendor information and our readers' ratings of vendor service and reliability in "The PC Magazine 200" and "Service & Reliability: Are You Getting What You Need?" elsewhere in this issue.

Armed with information about design, components, manageability, and support, we hope you'll find yourself on the track to building your own perfect PC. □

John Clyman is an associate editor at PC Magazine.

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800-252-9855

Next Systems
Princeton, NJ
609-771-0003

PC Express, Inc.
Richfield, NH
800-947-1100

PC Performance Centers
Englewood, CO
303-771-8030

PC Systems
West Palm Beach, FL
407-640-0811

PC Workstation
Bellevue, WA
206-641-4141

Pdms Pocket
Seattle, Washington
206-575-0949

Pony Computers Inc.
Indian, IL
800-888-7888

RAM, Inc.
Denver, CO
303-455-7094

Reggie, Inc.
Tampa, FL
813-624-5502

S.I.I. Audio Shack
Truth or Consequences, NM
505-894-5442

Sears Roebuck Systems
Palm Desert, CA
619-770-1818

Sevens Design Computers
San Diego, CA
619-537-3737

Singapore Computers
Burlington, CA
800-800-5550

TAP
New Brunswick, NJ
908-247-6000

Thor Computers, Ltd.
Albuquerque, NM
505-881-0077

Tyco Data
Sunnyvale, CA
800-888-5418

US Microtech
Milpitas, CA
408-455-5522

Nicholas Computers
Quebec, Canada
1-800-VEC-5435



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NexGen

Buying the Perfect PC

PC MAGAZINE'S 1995 COMPUTER-COMPARISON GUIDE

By John Clyman

With so many PCs and so many configurations to choose from, where do you start? Decide what factors matter to you—price, performance, components, purchase channel, vendor reputation—and go comparison shopping. Use the worksheet in this pullout section to help record your findings. Below are a few things you'll want to keep in mind.

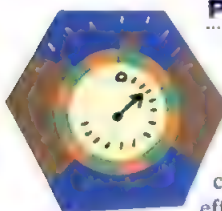
CONFIGURATION



Unless low price is an overriding concern, look for a Pentium-class system rather than a 486—especially if you're interested in multimedia. Aim for 16MB of RAM and get as large a hard disk as you can afford: 720MB for an entry-level system, 1GB if you can swing it, or 1.6GB to 2GB if you're a serious power user. You'll also want a quad-speed CD-ROM drive—to load software if for nothing else—and perhaps a sound card and speakers. Look for a 15-inch monitor or larger and a graphics card with at least 1MB of graphics memory. And think about features such as an inexpensive tape-backup system and an uninterruptible power supply, both of which can help keep you from losing crucial work.

On the facing page is a worksheet for comparing the features that different vendors offer. We've included our specific recommendations for entry-level, midrange, and high-end desktop systems.

PERFORMANCE

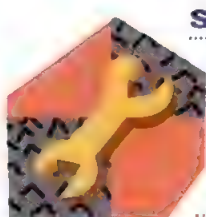


Seemingly minute differences among system configurations can result in dramatic differences in performance. The amount of RAM is one critical factor, as is the design of the hard disk subsystem. Of course, processor speed is a factor, and the efficiency of your graphics accelerator has an impact as well. Even the operating system you use can make a difference: Microsoft Windows for Workgroups 3.11 leads to better performance than Windows 3.1 on most machines.

On the inside of this pullout, we report the Winstone 95 test results for the 209 Pentium-class systems that we've tested in the past few months. Winstone 95 measures the performance of PCs running 13 popular mainstream applications. We also indicate where to find a detailed review of each system. The feature reviews include results from other test suites, including WinBench 95, which tests graphics and disk subsystem performance, and PC Bench 9.0, which tests CPU performance and DOS performance. This data is also available in an interactive, searchable format in stories included on the PC Magazine CD.

To help provide a context for the scores, we've included a chart that indicates the best, worst, and average performance of machines based on each type of processor.

SERVICE AND SUPPORT



Look for a warranty and on-site service plan suitable for your needs, but don't forget to consider a vendor's reputation for providing quality service and support. This pullout section contains the results of our current Service and Reliability survey, in which our readers rate their satisfaction with reliability, repair service, and technical support—and report the proportion of machines needing repair in the first 12 months of use—for 35 desktop PC vendors. If you want to know more about a vendor, such as its approximate net revenue, years in business, and number of employees, see "The PC Magazine 200" elsewhere in this issue.

PURCHASE CHANNEL



Direct vendors, which you call over the phone, tend to offer the widest range of custom configurations. You can tell them exactly what hardware (and often what software) you want in your machine, and they'll build it to order. Computer superstores typically offer vast selections of hardware and software from many vendors, but as in other retail outlets such as discount clubs, office marts, and electronics stores, the salespeople may not be especially well informed about the products they are selling. Value-added resellers (VARs) or consultants often help create complete, "turnkey" hardware and software systems, often including network solutions customized for your business. VARs may also help with installation and maintenance.

PRICE



The one truth of computer prices is that they'll continue to drop over time. Systems will get less expensive if you wait, but you'll also find that you need more power as time goes by. Today, a low-end 486DX2/66 system should cost as little as \$1,000; entry-level Pentium/75 machines sell for about \$1,500 to \$2,000. Pentium/100 and Pentium/120 machines can cost anywhere from \$2,000 to \$4,000 or more, depending on the configuration. Make sure the price you're quoted includes everything you'll need; some vendors leave out the price of a monitor, for example.

	Processor	Last reviewed	Winstone score
HiQ Neptune II P66/PCI	P/66	12/6/94	97
HiQ Neptune II P90/PCI	P/90	12/6/94	118
HP Vectra VL 5/75	P/75	5/30/95	117
HP Vectra VL 5/90	P/90	5/30/95	132
HP Vectra VL 5/120	P/120	5/30/95	141
HP Vectra XU 5/90C	P/90	12/6/94	107
HP Vectra XU 5/100C	P/100	5/30/95	160
HR P5-75 Tower	P/75	5/30/95	123
HR P5-100 Tower	P/100	5/30/95	147
IBM 750-P90	P/90	5/30/95	130
IBM Aptiva 730	P/60*	5/18/95	62
Insight PCI P60 MM	P/60*	12/20/94	51
Insight PCI P66 MM	P/66	12/6/94	131
Insight PCI P75 MM	P/75	5/30/95	124
Insight PCI P90 MM	P/90	12/6/94	145
Insight PCI P100 MM	P/100	5/30/95	172
Insight PCI P120 MM	P/120	5/30/95	103
ITI M54P1 90	P/90	12/6/94	95
Leading Edge Fortiva Series 5000	P/60*	5/18/95	50
Maximus Magna Media	P/75	5/30/95	123
Maximus Magna Graphics Media	P/100	5/30/95	149
Maximus Winmax95 Nx586	Nx586-P80	5/30/95	115
Maximus Musicmax Nx586	Nx586-P100	5/30/95	134
Mega Impact Pentium 100	P/100	5/30/95	153
Micro Express MicroFLEX-VL/P66	P/66	12/6/94	108
Micron P90 Home MPC	P/90*	5/16/95	94
Micron P100 Millennium	P/100	5/30/95	169
Micron P120 Millennium	P/120	5/30/95	190
Micron P75 PCI PowerStation	P/75	5/30/95	124
Micron P90 PCI PowerStation	P/90	12/6/94	144
MicroTech Ultima MP5/90	P/90	12/6/94	112
MidWest Micro Elite P5-66	P/66	12/6/94	104
MidWest Micro Elite Home PC P5-90	P/90*	12/20/94	96
MidWest Micro Elite P5-90	P/90	12/6/94	100
MidWest Micro P5-75 Office PC	P/75	5/30/95	124
MidWest Micro P5-100 Office PC	P/100	5/30/95	174
MidWest Micro P5-120 Office PC	P/120	5/30/95	184
Mitac Performance 75	P/75	5/30/95	103
Mitac Performance 100	P/100	5/30/95	95
Mitsuba Fileserver-P-90	P/90	12/6/94	113
NEC PowerMate P60D	P/60	12/6/94	100
NEC PowerMate VP75	P/75	5/30/95	111
NEC Ready PROAM	P/60*	12/20/94	80
NEC Ready 9510	P/90	5/16/95	84
NET/S N568 Best Buy	P/66*	12/20/94	80
NET/S N568 Best Buy	P/66	12/6/94	114
NET/S N568 PowerStation	P/66	12/6/94	102
NET/S N590 PowerStation	P/90	12/6/94	96
NMC Expert-Servant DP90	P/60	12/6/94	109
NMC Expert System P66	P/66	12/6/94	118
NMC Expert-System	P/75	5/30/95	114
Olivetti M4 82	P/60	12/6/94	99
Packard Bell Multimedia Pentium	P/75*	5/18/95	72
PC Express EXP90	P/90	12/6/94	105
PCB BurStar P60	P/60	12/6/94	95
Polywell Poly 575IP	P/75	5/30/95	114
Polywell Poly 590IP	P/90	12/6/94	111
Polywell Poly 510002	P/100	5/30/95	144
Precision PTI-66	P/66	12/6/94	92
Precision PTI-90	P/90	12/6/94	114
Reason Square S-LXP/IP-75	P/75	5/30/95	121
Reason Square S-LXP/IP-100	P/100	5/30/95	141
Robotech Cobra RS Home Runner P60	P/60	12/20/94	86
Robotech Cobra RS P90	P/90	12/6/94	136
Robotech Cobra RSUp103 Graphics Workstation	P/100	5/30/95	146
Royal P/66 Media Master IV	P/66	12/6/94	103
Royal P/90 Ultra Media	P/90	12/6/94	116
Sidus Formula SCI9P590PDT	P/90	12/6/94	146
Summit Mount Brooks	P/75	5/30/95	114
Summit Mount McKinley	P/100	5/30/95	167
Sys Business P66	P/66	12/6/94	101
Sys Performance P90	P/90	12/6/94	118
Sys Performance P100T	P/100	5/30/95	178
Tagram Platinum I	P/60*	12/20/94	83

* Equipped with 2MB of RAM.

WORST

BEST

	Processor	Last reviewed	Winstone score
Tagram Thunderbolt P75	P/75	5/30/95	130
Tagram Thunderbolt P100	P/100	5/30/95	159
Tangent NX5-P80	Nx586-P80	5/30/95	111
Tangent NX5 P100	Nx586-P100	5/30/95	130
Tangent PCI-575	P/75	5/30/95	123
Tangent PCI-590	P/90	12/6/94	118
Tangent PCI-5100	P/100	5/30/95	152
TC-P5-75 Media	P/75	5/30/95	114
Tri-Star Tri-CAD Pentium 66	P/66	12/6/94	101
Tri-Star Tri-CAD P-75 Personal Workstation	P/75	5/30/95	115
Tri-Star Tri-CAD Vigor	P/90	12/6/94	107
Tri-Star Tri-CAD NTP100 Personal Workstation	P/100	5/30/95	145
Unisys SVI 51007	P/100	5/30/95	134
Unitex UT P60	P/60	12/6/94	98
Unitex UT-P90	P/90	12/6/94	119
Unitex UT-P100	P/100	5/30/95	151
USA Flex PT-75 Desktop System	P/75	5/30/95	115
USA Flex PT-75 Multi-Media Classic	P/75*	5/16/95	62
USA Flex PT-100 Tower System	P/100	5/30/95	149
Vektron PCI Professional Multimedia	P/60	12/6/94	84
Vektron PCI Multimedia Ultimate	P/90	12/6/94	93
Vektron PCI Power Station	P/60	12/6/94	88
Vektron PCI Power Ultimate	P/90	12/6/94	90
Xinetron X/LAN P66	P/66	12/6/94	105
Xinetron X/LAN P90	P/90	12/6/94	101
ZDS Z Station EX MDH	P/90	5/30/95	141
Zenon PCI Dream Media 4X	P/100	5/30/95	170
ZEOS Pantera Pentium-66	P/66	12/6/94	132
ZEOS Pantera Pentium-75	P/75	5/30/95	123
ZEOS Pantera Pentium-90	P/90	12/6/94	150
ZEOS Pantera Pentium-100	P/100	5/30/95	146

* Equipped with 2MB of RAM.

WORST

BEST

SERVICE & RELIABILITY: DESKTOP PCs

A = Better than average on all measures

B = Combination of average and better-than-average scores

C = Average on all measures

D = Combination of average and worse-than-average scores

Current survey results

▲ = Significantly better than average

● = Average

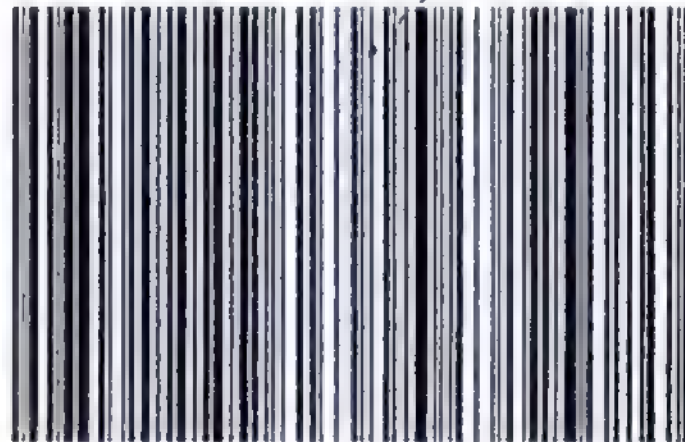
▼ = Significantly worse than average

Company	Grade	Repair	Reliability	Tech support	Percent needing repair
Acer	C				
ALR	B				▲
Apple/Macintosh	B		▲		▲
AST	B	▲	▲		▲
AT&T GIS	D		▼		
Austin	D				▼
Compaq	A	▲	▲	▲	▲
CompuAdd	D				▼
Compudyne	C				
Dell	B	▲	▲	▲	
Digital	A	▲	▲	▲	▲
DTK	C				
Epson	D		▼	▼	
Everex	D			▼	
Gateway	B	▲	▲	▲	
HP	A	▲	▲	▲	▲
Hyundai	D		▼		
IBM	A	▲	▲	▲	
Insight	B	▲	▲	▲	
Leading Edge	D	▼	▼	▼	
Micron	B	▲	▲	▲	
MidWest Micro	B		▲		
NEC	B				▲
Northgate	C			▲	▼
Packard Bell	C	▼		▼	▲
PC Brand	D			▼	▼
Samsung	C				
Tandy	D	▼	▼	▼	
Tri-Star	C				
Unisys	D		▼		
USA Flex	D				▼
Wang	D	▼	▼		
Wyse	D		▼		
ZDS	D	▼	▼	▼	
ZEOS	C	▲	▲	▲	▼

1. Follow instructions on the other side

Back

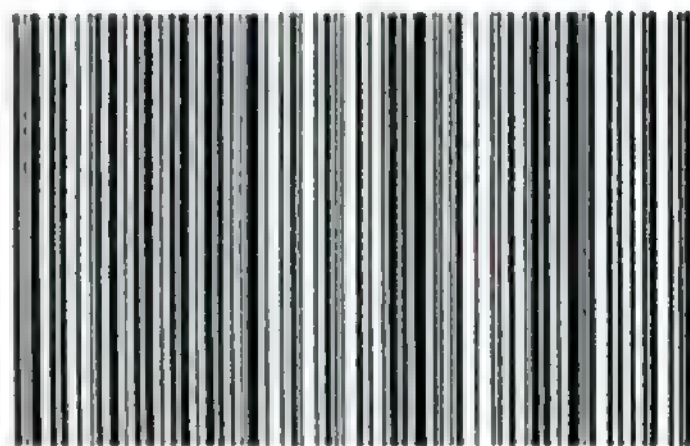
GbsSlipBack-001B



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Open the foldout page

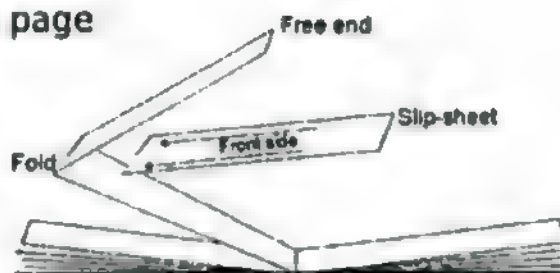
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

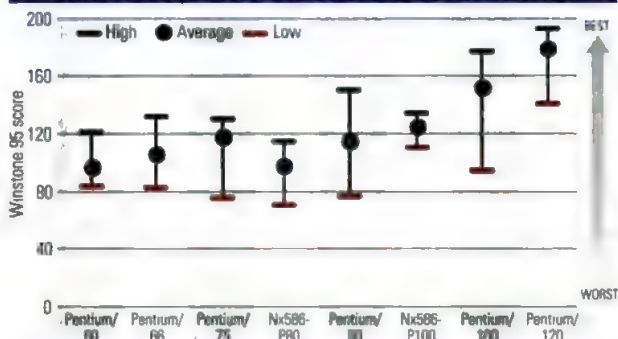
3. Slice the folded edge

4. Close the page and slip-sheet



If you want to know how fast a PC will run real applications, look at its Winstone 95 score. A score of 10 corresponds to the performance of a Compaq 386-DX/25; typical results for Pentium-class machines are charted at right. Each system below was tested with 16MB of RAM unless marked with an asterisk, indicating an 8MB configuration.

WINSTONE SCORES BY PROCESSOR



	Processor	Last reviewed	Winstone score
Aberdeen P100-PCI	P/100	5/30/95	151
Aberdeen NxP100	Nx586 P100	5/30/95	130
AcerAcros Pentium 75	P/75	5/30/95	125
AcerAcros Pentium Minntower	P/75*	5/16/95	55
AcerPower 8612TB	P/80*	12/20/94	87
AcerPower 60MHz Pentium	P/60	12/6/94	93
AcerPower 30MHz Pentium	P/60	12/6/94	111
AcerPower Pentium 120	P/120	5/30/95	174
ACMA P60 MPC	P/60*	12/20/94	73
ACMA P66 Tower	P/66	12/6/94	106
ACMA P75	P/75	5/30/95	120
ACMA P90 Tower	P/90	12/6/94	115
ACMA P100	P/100	5/30/95	153
Alaris Nx586 P100	Nx586 P100	5/30/95	127
AMAX Powerstation 85	P/66	12/6/94	108
AMAX Powerstation 75	P/75	5/30/95	123
AMAX Powerstation 90	P/90	12/6/94	118
AMAX Powerstation 100	P/100	5/30/95	153
AMS InfoGold Pentium/66	P/66	12/6/94	109
AMS InfoGold P75	P/75	5/30/95	118
AMS InfoGold Pentium/90	P/90	12/6/94	126
AMS InfoGold P100	P/100	5/30/95	144
AST Adventage! Adventure 5875p	P/75*	5/16/95	54
AST Bravo MS P/60	P/60	12/6/94	100
AST Premier GX P/90	P/90	12/6/94	119
AST Premier GX P/100	P/100	5/30/95	149
AT&T Globelyst 590	P/66	12/6/94	101
AT&T Globelyst 600	P/90	12/6/94	126
Austin Communications Manager P66	P/66	12/6/94	131
Austin Eduainer Plus	P/60	12/6/94	116
Austin Power Plus 75	P/75	5/30/95	126
Austin Power Plus 100	P/100	5/30/95	174
Austin Power Plus 120	P/120	5/30/95	186
Austin Power System 60	P/60	12/6/94	108
Austin Power System 90	P/90	12/6/94	115
Blackship NX-90 Nautilus	Nx586 P80	5/30/95	96
Blackship NX-100 Nautilus	Nx586 P100	5/30/95	128
CAF Lightning P6	P/66	12/6/94	101
CAF Lightning P9	P/90	12/6/94	90
Compaq Deskpro XL 586 Model 535/CDS	P/66	12/6/94	109
Compaq Deskpro XL 590 Model 536	P/60	5/30/95	129
CompuAdd CP60p Desktop	P/60	12/6/94	118
CompuAdd CP75p Desktop	P/75	5/30/95	122
CompuAdd CP90p Minntower	P/90	12/6/94	106
CompuAdd CP100p Minntower	P/100	5/30/95	168
Comtrade Multimedia Tornado 4X P75	P/75	5/30/95	123
Comtrade Multimedia Dream Machine P100	P/100	5/30/95	151
Comtrade PCI Best Buy 566	P/66	12/6/94	108
Comtrade PCI CAD/Publishing 586	P/66	12/6/94	108
Comtrade PCI CAD/Publishing 590	P/90	12/6/94	117
Cornell PCI Power Workstation	P/66	12/6/94	98
Cornell PCI Power Workstation/P75	P/75	5/30/95	111

* Equipped with 8MB of RAM

WORST

BEST

	Processor	Last reviewed	Winstone score
Cornell PCI/EISA Ultima Workstation	P/90	12/6/94	111
Cornell Ultima/P100	P/100	5/30/95	140
DataStor P5-66	P/66	12/6/94	87
DataStor P5-90	P/90	12/6/94	105
DataStor NX5-90	Nx586-P80	5/30/95	71
DataStor NX5-100	Nx586-P100	5/30/95	126
DECpc XL 566	P/66	12/6/94	104
DECpc XL 590	P/90	12/6/94	124
Dell Dimension XPS P60	P/60	12/6/94	87
Dell Dimension XPS P75	P/75	5/30/95	117
Dell Dimension XPS P90	P/90	5/30/95	136
Dell Dimension XPS P100	P/100	5/30/95	171
Dell Dimension XPS P120	P/120	5/30/95	185
Dell OmniPlex 560	P/60	12/6/94	91
Dell OmniPlex 590	P/90	12/6/94	106
Dell OptiPlex XM590	P/90	12/6/94	133
DI Diamond P100	P/100	5/30/95	142
Diamond Tornado P66	P/66	12/6/94	109
Diamond Thunder Power	P/75	5/30/95	120
Diamond Hurricane P90	P/90	12/6/94	123
Diamond Pentium Power Server	P/100	5/30/95	144
Digital Celebris 575	P/75	5/30/95	114
Digital Celebris XL 5100	P/100	5/30/95	151
DTK QUIN-32	P/60	12/6/94	88
DTK QUIN-35	P/75	5/30/95	76
DTK QUIN-52	P/100	5/30/95	115
Duracorn 586/66	P/66	12/6/94	83
Duracorn FilePro 586/90	P/90	12/6/94	81
Duracorn MiniPro Nx586-100	Nx586-P100	5/30/95	111
Dyna System 590	P/90	12/6/94	77
EPS P60 Phantom	P/60	12/6/94	121
EPS P90 Predator	P/90	12/6/94	143
Epson Endeavor P60	P/60	12/6/94	90
Ergo ThunderBrick 100+	P/100	5/30/95	165
Everex Step SP/75	P/75	5/30/95	113
Everex Step SP/100	P/100	5/30/95	136
Gain Master P560	P/60	12/6/94	67
Gateway P5-60 Family PC	P/60*	12/20/94	70
Gateway P5-60 Family PC	P/60	12/6/94	95
Gateway P5-75 Family PC	P/75*	5/16/95	75
Gateway P5-90 Family PC	P/90	12/6/94	106
Gateway P5-60	P/60	12/6/94	94
Gateway P5-75	P/75	5/30/95	124
Gateway P5-90XL	P/90	12/6/94	113
Gateway P5-100XL	P/100	5/30/95	177
Gateway P5-120	P/120	5/30/95	193
GST Apogee PT75	P/75	5/30/95	119
GST Apogee PT100	P/100	5/30/95	132
Hertz P66e	P/66	12/6/94	86
Hertz P75e	P/75	5/30/95	124
Hertz P90	P/90	12/6/94	91
Hertz P100e	P/100	5/30/95	168

* Equipped with 8MB of RAM

WORST

BEST



1995 Buyers' Worksheet

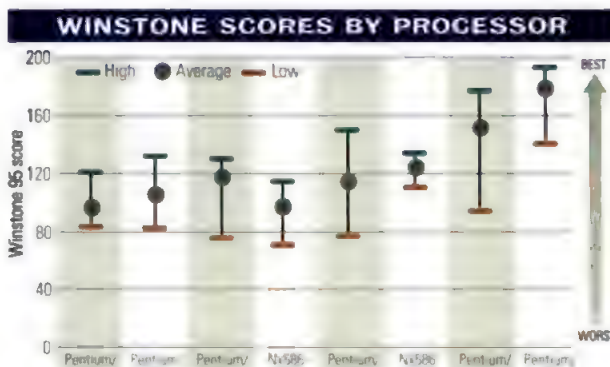
Trying to find your own Perfect PC?
Use this Buyers' Worksheet to compare
the systems you're interested in with the

configuration of our dream machine,
perfect corporate workstation, and per-
fect entry-level PC.

PERFECT PCs: PC MAGAZINE'S RECOMMENDATIONS			
Feature	The dream machine	Corporate workstation	Entry-level system
Processor	Pentium/133	Pentium/90 or Pentium/100	Pentium/75
L2 cache	512K synchronous	256K	256K
System memory	32MB EDO	16MB	8MB
Expansion bus	PCI and ISA	PCI and ISA	PCI and ISA
Hard disk	1.6GB Enhanced IDE or 2GB SCSI	1GB Enhanced IDE	720MB Enhanced IDE
CD-ROM drive	Quad-speed, multidisk	Quad-speed	Quad-speed
Sound card	16-bit wavetable	16-bit FM	16-bit FM
Speakers	3-piece with subwoofer	2-piece	2-piece
Graphics memory	4MB VRAM	2MB DRAM or VRAM	1MB DRAM
Monitor size	21-inch	17-inch	15-inch
Modem	28.8-Kbps external	14.4-Kbps internal	14.4-Kbps internal
Network interface card	10-100 Mbps Ethernet	10 Mbps Ethernet	10-Mbps Ethernet (optional)
Floppy disk drive	1.44MB and 1.2MB combo	1.44MB	1.44MB
Tape backup	DAT	Network server	Travan (optional)
Uninterruptible power supply	450-wa	Optional	Optional
High-speed serial and parallel ports	16550 UART, ECP/EPP	16550 UART, ECP/EPP	16550 UART, ECP/EPP
Infrared port	IrDA-compliant	Optional	Optional
PCMCIA slots	Optional	Optional	Optional
Keyboard and mouse	Standard	Standard	Standard
DOS and Microsoft Windows	Standard	Standard	Standard
Software bundle	Optional	Optional	Optional
Warranty	3 years	3 years	1 year
On-site service	3 years	1 year	1 year
Total price	\$8,000	\$4,000	\$2,000

PERFECT PCs: YOUR THREE CANDIDATES			
Feature	Model:	Model:	Model:
Processor			
L2 cache			
System memory			
Expansion bus			
Hard disk			
CD-ROM drive			
Sound card			
Speakers			
Graphics memory			
Monitor size			
Modem			
Network interface card			
Floppy disk drive			
Tape backup			
Uninterruptible power supply			
High-speed serial and parallel ports			
Infrared port			
PCMCIA slots			
Keyboard and mouse			
DOS and Microsoft Windows			
Software bundle			
Warranty			
On-site service			
Total price (including tax and shipping)			

If you want to know how fast a PC will run real applications, look at its Winstone 95 score. A score of 10 corresponds to the performance of a Compaq 386-DX/25; typical results for Pentium-class machines are charted at right. Each system below was tested with 16MB of RAM unless marked with an asterisk, indicating an 8MB configuration.



	Processor	Last reviewed	Winstone score
Aberdeen P100-PCI	P/100	5/30/95	151
Aberdeen P100-PCI	P/100	5/30/95	130
AcerAcros Pentium 75	P/75	5/30/95	125
AcerAcros Pentium Minitor	P/75*	5/16/95	95
AcerPower 861210	P/90*	12/20/94	81
AcerPower 60MHz Pentium	P/60	12/6/94	93
AcerPower 60MHz Pentium	P/60	12/6/94	91
AcerPower Pentium 120	P/120	5/30/95	174
ACMA P60 MPC	P/60*	12/20/94	75
ACMA P66 Tower	P/66	12/6/94	106
ACMA P75	P/75	5/30/95	120
ACMA P90 Tower	P/90	12/6/94	115
ACMA P100	P/100	5/30/95	153
Alaris Nx586 P100	Nx586 P100	5/30/95	127
AMAX Powerstation 60	P/66	12/6/94	100
AMAX Powerstation 75	P/75	5/30/95	123
AMAX Powerstation 90	P/90	12/6/94	118
AMAX Powerstation 100	P/100	5/30/95	153
AMS InfoGold Pentium 90	P/90	12/6/94	100
AMS InfoGold P75	P/75	5/30/95	118
AMS InfoGold Pentium 90	P/90	12/6/94	120
AMS InfoGold P100	P/100	5/30/95	144
AST Advantage! Advantage 9000	P/75*	5/16/95	94
AST Bravo MS P/60	P/60	12/6/94	100
AST Premia GX P/60	P/60	12/6/94	119
AST Premia GX P/100	P/100	5/30/95	149
AT&T Globalyst 500	P/66	12/6/94	101
AT&T Globalyst 600	P/90	12/6/94	126
Austin Communications Manager P90	P/90	12/6/94	121
Austin Edutainer Plus	P/60	12/6/94	116
Austin Power Plus 75	P/75	5/30/95	120
Austin Power Plus 100	P/100	5/30/95	174
Austin Power Plus 120	P/120	5/30/95	180
Austin Power System 60	P/60	12/6/94	108
Austin Power System 90	P/90	12/6/94	119
Blackship NX-80 Nautilus	Nx586 P80	5/30/95	96
Blackship NX-100 Nautilus	Nx586 P100	5/30/95	120
CAF Lightning P6	P/66	12/6/94	101
CAF Lightning P6	P/60	12/6/94	96
Compaq Deskpro XL 566 Model 535/CDS	P/66	12/6/94	109
Compaq Deskpro XL 590 Model 535	P/90	5/30/95	126
CompuAdd CP600 Desktop	P/60	12/6/94	118
CompuAdd CP750 Desktop	P/75	5/30/95	122
CompuAdd CP900 Minitor	P/90	12/6/94	106
CompuAdd CP1000 Minitor	P/100	5/30/95	160
Comrade Multimedia Tornado 4X P75	P/75	5/30/95	123
Comrade Multimedia Dream Machine Pro	P/100	5/30/95	151
Comrade PCI Best Buy 566	P/66	12/6/94	108
Comrade PCI CAD/Publishing 500	P/66	12/6/94	100
Comrade PCI CAD/Publishing 590	P/90	12/6/94	117
Cornell PCI Power Workstation	P/66	12/6/94	88
Cornell PCI Power Workstation/P75	P/75	5/30/95	111

* Equipped with 8MB of RAM

WORST

BEST

	Processor	Last reviewed	Winstone score
Cornell PCI EISA Ultima Workstation	P/90	12/6/94	111
Cornell PCI EISA Ultima Workstation	P/90	5/30/95	140
DataStor P5-66	P/66	12/6/94	97
DataStor P5-90	P/90	12/6/94	105
DataStor NX5-90	Nx586 P90	5/30/95	71
DataStor NX5-100	Nx586 P100	5/30/95	126
DECpc XL 500	P/66	12/6/94	104
DECpc XL 590	P/90	12/6/94	124
Dell Dimension XPS P60	P/66	12/6/94	81
Dell Dimension XPS P75	P/75	5/30/95	117
Dell Dimension XPS P90	P/90	5/30/95	130
Dell Dimension XPS P100	P/100	5/30/95	171
Dell Dimension XPS P120	P/120	5/30/95	185
Dell OmniPlex 560	P/60	12/6/94	91
Dell OmniPlex 590	P/90	12/6/94	105
Dell OptiPlex XM590	P/90	12/6/94	133
DPS Diamond P100	P/100	5/30/95	142
Diamond Tornado P66	P/66	12/6/94	109
Diamond Thunder Power	P/75	5/30/95	120
Diamond Hurricane P90	P/90	12/6/94	123
Diamond Pentium Power Server	P/100	5/30/95	144
Digital Celebris 575	P/75	5/30/95	114
Digital Celebris XL V100	P/100	5/30/95	131
DTK QUIN 32	P/60	12/6/94	88
DTK QUIN-35	P/75	5/30/95	75
DTK QUIN 52	P/100	5/30/95	115
Duracom 586/60	P/60	12/6/94	81
Duracom FilePro 586/90	P/90	12/6/94	81
Duracom MiniPro Model 100	Nx586 P100	5/30/95	111
Dyna System 590	P/90	12/6/94	77
EPS P60 Phantom	P/60	12/6/94	121
EPS P90 Predator	P/90	12/6/94	143
Epson Endowor P60	P/60	12/6/94	80
Ergo ThunderBrick 100+	P/100	5/30/95	165
Everex Step SP/75	P/75	5/30/95	118
Everex Step SP 100	P/100	5/30/95	136
Gain Master P660	P/60	12/6/94	81
Gateway P5 60 Family PC	P/60*	12/20/94	70
Gateway P5-80 Family PC	P/80	12/6/94	85
Gateway P5 75 Family PC	P/75*	5/16/95	75
Gateway P5-90 Family PC	P/90	12/6/94	105
Gateway P5-60	P/60	12/6/94	94
Gateway P5-75	P/75	5/30/95	124
Gateway P5 90XL	P/90	12/6/94	113
Gateway P5-1000	P/100	5/30/95	177
Gateway P5 120	P/120	5/30/95	193
GST Apogee P175	P/75	5/30/95	119
GST Apogee P1100	P/100	5/30/95	132
Hertz P66	P/66	12/6/94	85
Hertz P75e	P/75	5/30/95	124
Hertz P90	P/90	12/6/94	81
Hertz P100e	P/100	5/30/95	168

* Equipped with 8MB of RAM

WORST

BEST

1995 Buyers' Worksheet

Trying to find your own Perfect PC?
Use this Buyers' Worksheet to compare
the systems you're interested in with the

configuration of our dream machine,
perfect corporate workstation, and per-
fect entry-level PC.

PERFECT PCs: PC MAGAZINE'S RECOMMENDATIONS			
Feature	The dream machine	Corporate workstation	Entry-level system
Processor	Pentium 133	Pentium 90 or Pentium 100	Pentium 75
L2 cache	512K synchronous	256K	256K
System memory	32MB EDO	16MB	8MB
Expansion bus	PCI and ISA	PCI and ISA	PCI and ISA
Hard disk	1.6GB Enhanced IDE or 2GB SCSI	1GB Enhanced IDE	720MB Enhanced IDE
CD-ROM drive	One 1-speed full-disc	Quad-speed	Quad-speed
Sound card	16-bit wavetable	16-bit FM	16-bit FM
Speakers	3-piece with subwoofer	2-piece	2-piece
Graphics memory	4MB VRAM	2MB DRAM or VRAM	1MB DRAM
Monitor size	21-inch	17-inch	15-inch
Modem	28.8 Kbps external	14.4 Kbps internal	14.4 Kbps internal
Network interface card	10-100Mbps Ethernet	10-Mbps Ethernet	10-Mbps Ethernet (optional)
Floppy disk drive	1.44MB and 1.2MB drives	1.44MB	1.44MB
Tape backup	DAT	Network server	Travan (optional)
Uninterruptible power supply	450-wa	Optional	Optional
High-speed serial and parallel ports	16550 UART ECP EPP	16550 UART ECP EPP	16550 UART ECP EPP
Infrared port	IrDA-compliant	Optional	Optional
PCMCIA slots	Optional	Optional	Optional
Keyboard and mouse	Standard	Standard	Standard
DOS and Microsoft Windows	Standard	Standard	Standard
Software bundle	Optional	Optional	Optional
Warranty	3 years	3 years	1 year
On-site service	3 years	1 year	1 year
Total price	\$8,000	\$4,000	\$2,000

PERFECT PCs: YOUR THREE CANDIDATES			
Feature	Model:	Model:	Model:
Processor			
L2 cache			
System memory			
Expansion bus			
Hard disk			
CD-ROM drive			
Sound card			
Speakers			
Graphics memory			
Monitor size			
Modem			
Network interface card			
Floppy disk drive			
Tape backup			
Uninterruptible power supply			
High-speed serial and parallel ports			
Infrared port			
PCMCIA slots			
Keyboard and mouse			
DOS and Microsoft Windows			
Software bundle			
Warranty			
On-site service			
Total price (including tax and shipping)			

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Holy cow! Gateway 2000® has the fastest Pentium processor-based PCs in the world! Proclaimed the "fastest PC on the market" by *PC Magazine*,† the Gateway 2000 P5-120XL has taken the PC world by storm. But hold on to your hats because Gateway has introduced a system that's even faster — the P5-133XL!

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And buying a PC from Gateway 2000 couldn't be easier. Just call 800-846-6947 and a friendly Gateway 2000 sales representative will take your order. Have a special configuration in mind? No problem! We'll be happy to custom build a system for you.

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†PC Magazine, April 25, 1995

P5-133XL

- Intel® 133MHz Pentium® Processor*
- 16MB EDO Performance-Enhanced Memory
- 256K Pipelined Burst Cache
- 1.62GB 10ms IDE Hard Drive w/ Mode 4 Support
- PCI Enhanced IDE Interface
- ATI Mach 64 Graphics Accelerator w/ 2MB VRAM
- 4X 3-CD Changer
- 16-Bit Ensoniq® Wavetable Audio & Altec™ ACS-31 Speakers w/ Subwoofer
- TelePath™ II 28.8 Fax/Modem Communication Center
- 3.5" Diskette Drive
- 17" .26dp Vivitron™ Color Monitor
- 9-Bay Tower Case
- AnyKey® Keyboard and Microsoft® Mouse 2.0

- MS-DOS® 6.22 and WFW 3.11
- MS Office Professional 4.3,** Bookshelf,® Money 3.0
- 3-Year Limited Parts Warranty

\$4399

P5-120XL \$3999

- Intel 120MHz Pentium Processor*
- TelePath II v 14.4K Fax/Modem Communication Center



P5-120 BEST BUY

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- 256K Pipelined Burst Cache
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X CD-ROM
- 3.5" Diskette Drive
- 15" .25dp Vivitron Color Monitor
- 7-Bay Desktop Case
- AnyKey Keyboard and MS Mouse 2.0
- MS-DOS 6.22 and WFW 3.11
- MS Office Professional 4.3,** Bookshelf, Money 3.0
- 3-Year Limited Parts Warranty

\$2999

**MS Office Professional 4.3, Bookshelf, Money 3.0

*Intel Pentium Processor

1940

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CIRCLE 158 ON READER SERVICE CARD

Inside the Perfect Display

This year, the focus is on self-aware monitors and graphics cards, better utilities, and more configuration options.

By Lance Ulanoff

The speed with which display technology is developing makes describing the Perfect Display like shooting at a moving target. As with the Perfect PC, there isn't *one* perfect display system for every user. Here we've identified three display systems (each composed of the display itself and the graphics controller): the perfect desktop display system, the perfect graphics professional display system, and the perfect road warrior display system.

The years you spent staring at monochrome DOS screens are now long gone. Today, you need more screen real estate for your GUI applications. While 14- and 15-inch screens were de rigueur two years ago, the price of 17-inch screens is finally starting to come down enough to make



DISPLAY SYSTEM

A display system (the monitor and graphics accelerator working in conjunction with each other) is perfect only insofar as it meets your needs. The two systems illustrated here satisfy the needs of desktop users and graphics professionals.

Graphics card driver

This driver should include such usability features as on-the-fly resolution switching, virtual display, plug-and-play capability, and adjustable refresh rates. Flexibility is also important, and the driver should support multiple environments (Microsoft Windows 3.1, OS/2 Warp). All of this must be backed up with a three-year extended warranty.

DESKTOP DISPLAY

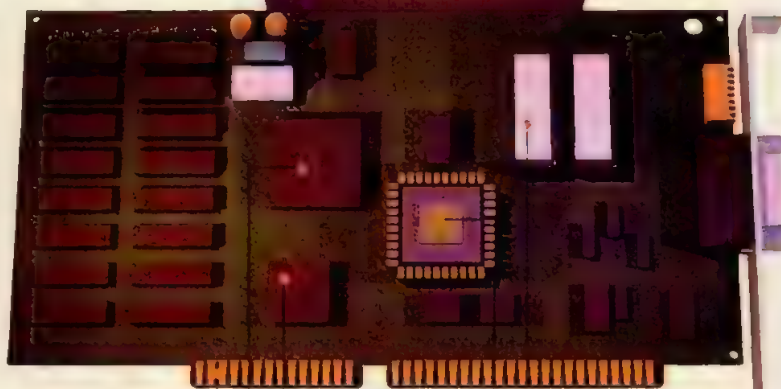
Desktop users typically search for efficiency and performance that will move them from page 1 to page 96 of a prospectus in a flash.

Price: \$1,000.



Monitor

This 17-inch monitor should feature on-screen controls, plug-and-play ability, DDC support, DPMS energy-conservation modes, a noninterlaced screen, a degaussing button, and multiple synchronizations, including 1,024-by-768 at 76 Hz. **Price: \$800.**



Graphics accelerator

- MPEG playback chip
 - High-speed RAMDAC
 - PCI bus
 - 2MB of VRAM or DRAM
 - 64-bit accelerator chip
 - Built-in digital-video-playback interpolation
 - DDC support
- Price: \$300.**

them a viable alternative. (The current upswing in prices, partly because of a tube shortage, should be a blip in an otherwise downward trend.) The 17-inch screens support optimal screen resolutions of 1,024-by-768 pixels. Of course, 21-inch monitors support excellent resolutions as well, but 17-inch monitors, unlike their bigger brothers, fit neatly on top of a mid-size PC and don't overwhelm your desk. These monitors are also significantly less expensive than 21-inch displays, which can cost upward of \$1,600.

Other standards that haven't changed since last year include noninterlaced operation, display power management (or Energy Star compliance) to power off the monitor automatically or power it down

after a user-specified time of inactivity (screen savers are lots of fun, but not exactly environmentally correct; they keep the screen running *especially* when no one's using it), MPRII low-emissions compliance, and antiglare coating.

Among the new features you should expect to find on your perfect monitor this year is plug-and-play ability. In fact, it may be the most significant improvement to monitor operation this year.

Using the VESA's Display Data Channel (DDC) specification (see "How the Perfect Monitor Works"), a plug-and-play monitor communicates with the graphics accelerator card to configure it automatically for proper operation without any user intervention. The informa-

tion stored within the monitor may include maximum bandwidth and maximum refresh rate and resolution, as well as whether or not the monitor supports MPRII and power management.

SHARP CARDS

Integral to the perfect display system setup is the graphics accelerator card. There's little reason to use a controller chip that features a data path less than 64 bits wide. In addition, you'll want at least 2MB of VRAM to support a 1,024-by-768 resolution at 65,000 colors.

With the CD-ROM explosion and built-in CD-ROM drives now commonplace, multimedia has become a part of our everyday lives. As a result, some form

GRAPHICS PROFESSIONAL DISPLAY

Graphics professionals' color-rich illustrations, page layouts, and 3-D designs put inordinately heavy demands on the average display system. **Price: \$4,000.**

Digital video capture card

You'll need the following features to import, manipulate, and export digital video images

- S-Video in and out ports
- Composite in port
- NTSC/PAL out port
- Hardware-assisted compression

Price \$700

Graphics card driver

In addition to the features noted on the perfect desktop display, the graphics pro's driver should add zoom and bird's-eye-view features as well as CAD drivers

Monitor

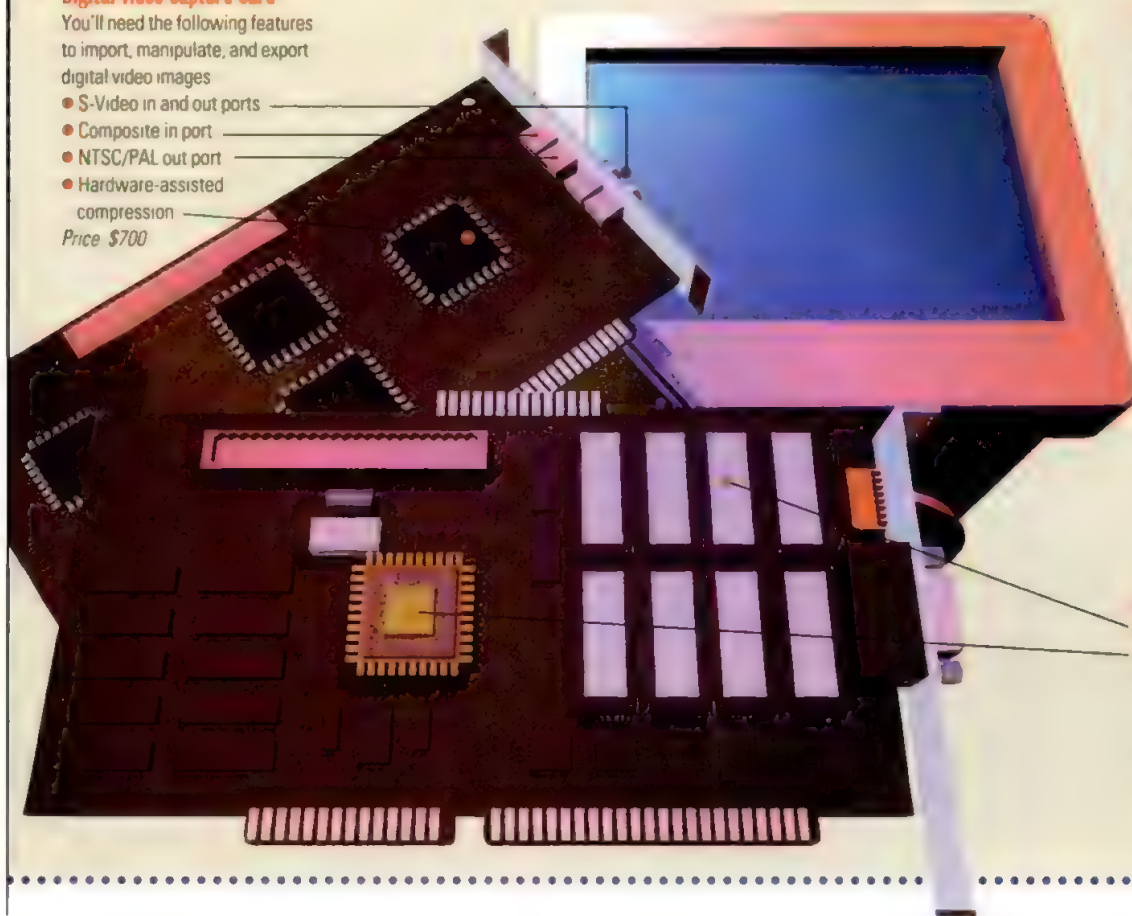
This 21-inch display should fill the needs of the graphics pro by including a bandwidth capable of handling resolutions up to 1,280-by-1,024 at refresh rates of 72 Hz or greater. Convergence controls and precise digital controls are also a must for this class of display

Price \$2,500

Graphics accelerator

- 4MB to 8MB of VRAM
- 64-bit accelerator chip (or greater) with built-in digital-video-playback scaling and DCI support

Price \$800 to \$1,800



of digital video playback acceleration and scaling is a must.

New to this year's display equation is MPEG video (Motion Picture Experts Group) playback support. Although there is a handful of software-based playback solutions, hardware-based MPEG outperforms software decompression on most sub-Pentium/90 systems. Also key to the digital-video playback picture is

DCI support. (At press time, the Display Control Interface spec was being renamed in its second release to Direct Draw.) Standing beside Window's GDI as an interface to external devices, DCI allows direct writes to the graphics accelerator for color-space conversion and direct access to the frame buffer. (See "How the Perfect Graphics Accelerator Works.")

JUST LIKE THE PROS

The graphics professional's perfect display system shares many of the same basic features as the desktop user's system, but the tasks a graphics professional faces—desktop publishing, 3-D design, 24-bit paint projects—call for a 21-inch monitor.

This monitor must be capable of supporting resolutions ranging from 1,280-by-1,024 to 1,600-by-1,280 and color depths

HOW THE PERFECT DISPLAY WORKS

Monitor intelligence

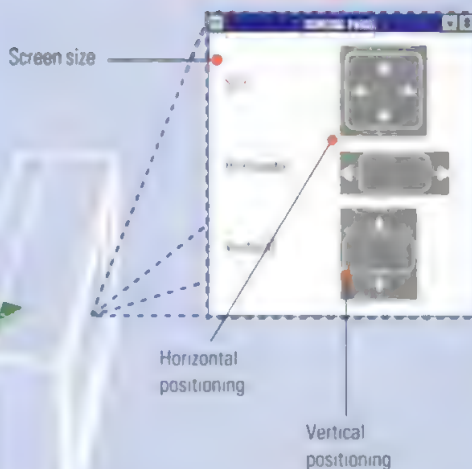
Inside most monitors is firmware that may include information regarding on-screen configuration and general guidelines for the monitor's operations. Firmware may also include information for plug-and-play functionality. For monitors, this means meeting specifications set forth by the Video Electronics Standards Association (VESA). The Display Data Channel (DDC) specification calls for a

monitor to transfer Extended Display Identification (EDID) continuously from its own internal hardware to the host graphics accelerator card. Included in this 128-bit block of information are specifications for VESA and other standard timings, DPMS (display power-management signaling) support, display parameters such as size and color, and a vendor product ID.

Monitor specs

Bandwidth	54 MHz
Dot pitch	0.33 mm
Maximum refresh rate	100 kHz
MPR II	yes
DPMS	yes
Maximum resolution	1,280 by 1,024

On-screen display controls



It all adds up

Sure, you can run your perfect 17-inch monitor at a low 640-by-480 resolution with 16 colors and use less than 256K of RAM. But you'll more likely be running at 800-by-600 with 65,000 to

16.7 million colors. And in that case, you'll need at least 2MB of RAM. The formula used to figure out how much memory you need for a given resolution and color depth is as follows:

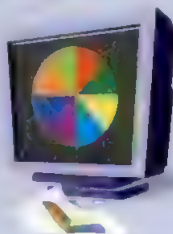
Resolution height x resolution width x bytes per pixel
(16 colors = 0.5 byte, 256 colors = 1 byte, 65,000 = 2 bytes, 16.7 million = 3 bytes)

640-by-480 with 16 colors	800-by-600 with 65,000 colors	1,024-by-768 with 16.7 million colors	1,280-by-1,024 with 16.7 million colors
150K RAM	960K RAM	2.4MB RAM	3.93MB RAM

Color wheel

The most basic color-calibration device usually employs a color wheel or chart (or some sample output) that you can place alongside your screen until you've adjusted the colors or gamma to match. This may also involve printing out a sample and seeing how

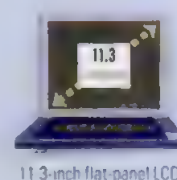
closely it resembles both the original provided by the vendor and its on-screen counterpart.



Display size

LCD monitors have added a new twist to the viewable-screen-area conundrum. Whereas a 17-inch CRT display actually provides only 15 inches (diagonal) of viewable

space, an 11.3-inch LCD provides 11.3 inches of viewing space. More interesting, an 11.3-inch display has almost as much viewable space as a 14-inch CRT display.



11.3-inch flat-panel LCD



17-inch CRT display

A word about Viking Components:

Innovation



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In A Monitor.

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ROAD WARRIOR DISPLAY

Notebook users need clarity, color, and the flexibility to hook up their systems to conventional CRTs. The days of display quality that was almost as bad as an old LCD watch are long gone. Today, those who compute and carry can expect decent resolution, bright colors, and ghostless images from their LCDs.

Graphics accelerator

- 32-bit (at 800-by-600 resolution, not much more is needed)
- Support for at least 800-by-600 resolution with 16-bit color on an external monitor
- Digital-video-playback interpolation (a must if you're running CDs on the road)
- Virtual display support (an 11.3-inch screen is good, but this feature can quadruple the size of your screen)

Display

- Active-matrix color
- 11.3-inch or larger display
- 800-by-600 resolution
- 45-degree viewing angle
- Brightness and contrast controls

Video memory

- 1MB of DRAM
(2MB would impose a drain on the system)

no lower than 16.7 million colors, all at an acceptable refresh rate of at least 75 Hz.

Graphics professionals also put a greater set of demands on the graphics accelerator card. While a 64-bit accelerator should be sufficient, the on-board memory should be upgraded anywhere from 4MB to 8MB of VRAM. Dual-ported VRAM is more expensive than DRAM, but it also provides the speed that graphics pros need.

ON THE ROAD

This is the first time we've specified the road warrior's perfect display system.

We do so because it looks as if the specifications for the desktop user's and road warrior's display systems are beginning to converge. Of course, notebook display technology is still a step behind the standard.

The perfect notebook display should include no less than a 32-bit graphic controller and 1MB DRAM (DRAM is used because it's less power-intensive than VRAM). With CD-ROMs now being

built into more and more notebooks, digital video acceleration is also a must.

As for the LCD, active-matrix remains the best choice for notebook displays. It provides a wide sweep of viewing angles, a bright picture, and deep colors (see "How LCDs Work"). Currently, most LCDs support resolutions of either 640-by-480 resolution or 800-by-600, but even higher-resolution LCD panels are now being introduced, and next year we may

Our Contributors: KATHLEEN CASTER is a staff editor of *PC Magazine*.

LANCE ULANOFF was the associate editor in charge of this story, and JEFF MACE was the project leader.

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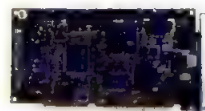
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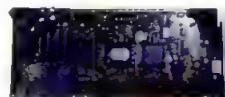
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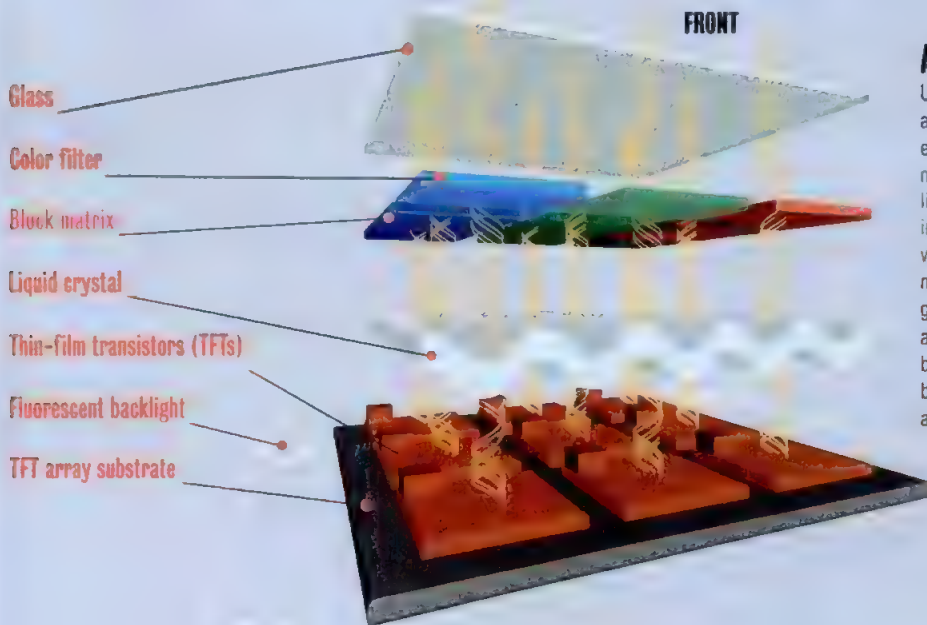
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How LCDs Work

A notebook display uses a combination of fluorescent-based backlighting, color filters, transistors, and liquid crystal as a sort of fluid venetian-blind system to create and illuminate images.

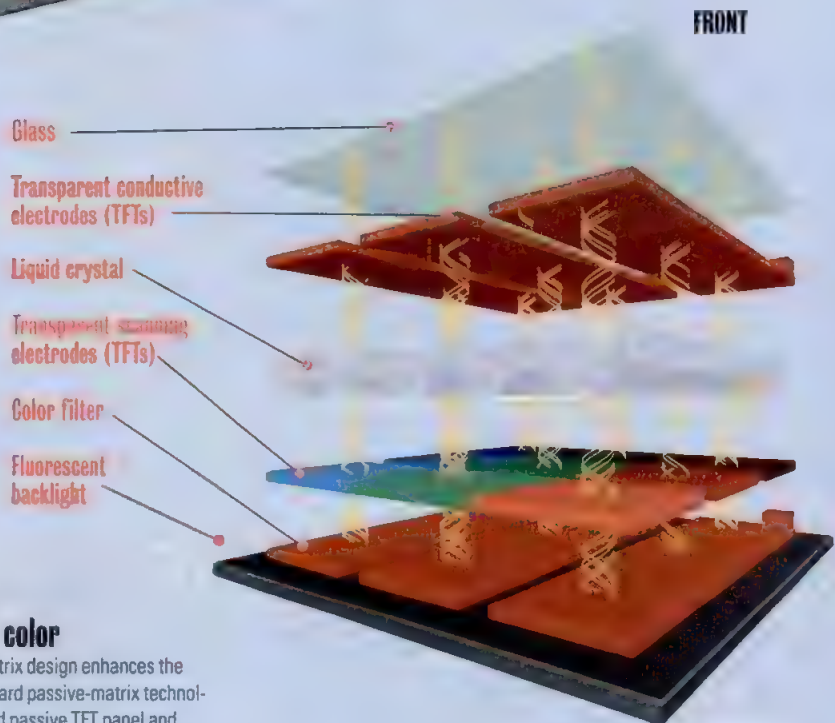


Active-matrix color

Unlike passive-matrix displays, in which vertical and horizontal line substrates are placed opposite each other with the crystal in between, active-matrix design places vertical and horizontal TFT lines on one plane to form a true matrix. Each intersection becomes a transparent dot electrode with TFTs attached to it. Each color dot on the matrix has three transistors: one each for red, green, and blue. (Because it is impossible to take apart an LCD once it has been manufactured, and because each transistor needs a backup that can be activated if it fails in factory testing, there are actually six transistors per dot.)

Passive-matrix color

A passive-matrix screen employs two layers of TFT line substrates, set crosswise to each other and separated by liquid crystal. Although the image is read serially by the graphics controller, the LCD panel must read in a row at a time before sending the image to the screen. There is also a certain degree of cross-talk interference between the two TFT substrate levels.



Dual-scan passive-matrix color

Dual-scan passive-matrix design enhances the image quality of standard passive-matrix technology by adding a second passive TFT panel and placing it crosswise against the first one. This halves the number of lines that must be scanned for each image refresh, which results in enhanced dot control and a better, brighter image. Overall, however, the color saturation still does not match that of active-matrix displays.



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Here's something you may not know... certain monitors may be harmful to your health. When facing some you may be exposing your family or your employees to unhealthful emissions. With that in mind, ViewSonic has adopted TCO, the **strictest** Swedish



standard, for many of our new monitors, including our new ViewSonic 17GS. This standard is more stringent than the older MPR-II or Energy Star™ guidelines. The unique benefits of TCO certification include substantial reductions in heat emissions, power consumption and decreased exposure to electromagnetic fields.

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PC and MAC compatible

Product	ViewSonic 17GS	ViewSonic 17GA	ViewSonic 17PS
CRT (Viewable)	17" (15.7")	17" (16.0")	17" (15.7")
Dot Pitch	0.27mm	0.27mm	0.25mm
<i>Plug & Play</i> +	YES	YES	YES
TCO Certified	YES	YES	YES
Max Resolution	1,280 x 1,024	1,280 x 1,024	1,600 x 1,280
Built in Speakers		YES	

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OK

Cancel

Help



THE PERFECT PC The Perfect Display

be recommending 64-bit acceleration with at least 2MB of DRAM. Larger LCD screens are also coming into vogue, and we recommend 11.3 inches or larger.

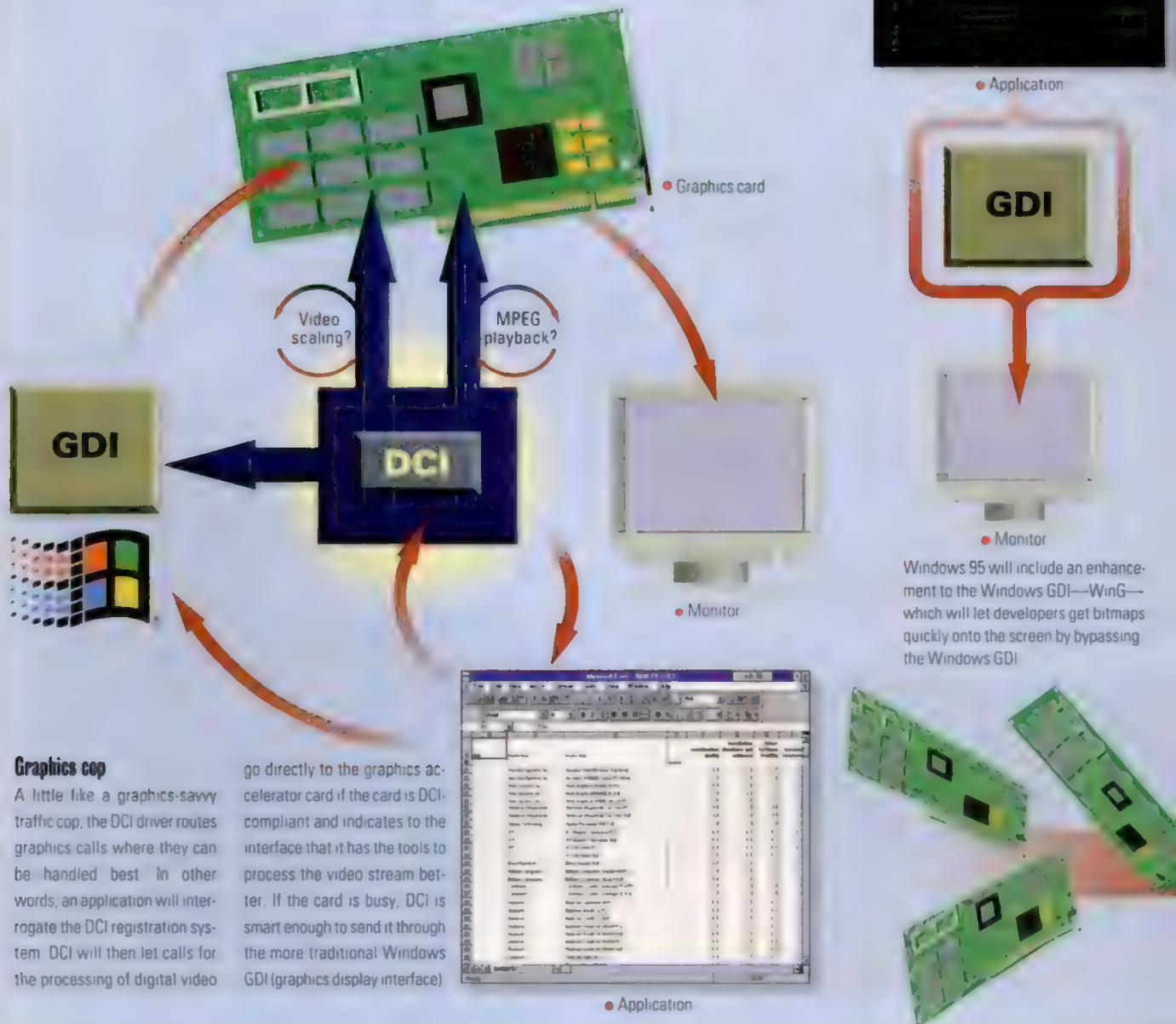
LCD-panel technology isn't just for notebooks anymore. Desktop flat-panel LCDs still cost nearly \$10,000, but that will improve. And higher resolutions, low power needs, small size, and nearly nonexistent

emissions of LCD-panel technology may make them more attractive for desktops in the future. In addition, the viewing space provided in an 11.3-inch LCD panel is *really* a full 11.3 inches diagonally. When it comes to screen size, CRTs could use truth in advertising. Even our recommended 17-inch screen will provide only 15 inches of viewing space measured diagonally.

TECHNICAL NOTES

To find your perfect display system, you'll need to understand a couple of basic principles behind display technology. Two items of concern for most users are *refresh rate* (most monitors are set to receive 72 Hz, with each hertz equaling one cycle per second) and *bandwidth*. The latter is a preset figure that deter-

HOW THE PERFECT GRAPHICS ACCELERATOR WORKS



Graphics cop

A little like a graphics-savvy traffic cop, the DCI driver routes graphics calls where they can be handled best. In other words, an application will inter-

rogate the DCI registration system. DCI will then let calls for the processing of digital video go directly to the graphics accelerator card if the card is DCI-compliant and indicates to the interface that it has the tools to process the video stream better. If the card is busy, DCI is smart enough to send it through the more traditional Windows GDI (graphics display interface)

Windows 95 will include an enhancement to the Windows GDI—WinG—which will let developers get bitmaps quickly onto the screen by bypassing the Windows GDI.

mines the amount of data your monitor can handle without distortion.

The reason bandwidth is important is that you will want to make sure that the monitor you buy can handle the resolutions and refresh rates you desire. To do so, use the following formula to figure out acceptable bandwidths for your desired configuration. Remember, any refresh

rate less than 72 Hz may cause eye-fatiguing flicker, so try to use that rate as a base for all your calculations.

$$\begin{aligned} \text{Horizontal pixels} \times \text{vertical pixels} \times \\ \text{refresh rate} &= \text{pixel speed}; \\ \text{pixel speed} \times 1.5 \text{ (for overhead)} &= \\ &\text{acceptable bandwidth.} \end{aligned}$$

In the coming months, users shopping for the perfect graphics accelerator will be

faced with a mind-numbing array of new graphics memory technologies (see "Memory Architectures: More Ideas, More Choices"). Among the memory types that will populate this next generation of graphics cards are standard VRAM and DRAM, EDO DRAM and EDO VRAM, Rambus DRAM, and WRAM.

EDO (or Extended Data Out) RAM has already begun to appear on cards, primarily because it's so easy to implement. Graphics accelerator-chip manufacturers and memory-chip vendors are able to use the single-ported EDO DRAM (and the dual-ported EDO VRAM) technology without changing their chip designs. EDO

***Remember: Setting your
monitor refresh rate
any lower than 72 Hz
may cause eye-fatiguing
screen flicker.***

memory's benefit, aside from being one of the most affordable new technologies, is that it can start a new memory cycle before it finishes with the current memory cycle, thereby increasing the memory's data bandwidth or throughput.

WRAM (Windows RAM) differs from EDO in many ways. Unlike EDO, it's a single-source technology: Samsung is currently the only memory vendor supplying this memory type. Also, WRAM is looked upon as the next generation of the faster VRAM technology (and a truer successor than EDO VRAM). According to vendors preparing to use this memory type, it will be faster than standard VRAM, and has special features designed to speed graphics operations under Windows including BITBLT raster operations and nonaligned memory-to-screen copying.

RDRAM (Rambus DRAM) is really the same internally as standard DRAM. The 500-Mbps Rambus interface reportedly makes it far more efficient than standard DRAM.

The array of options you face today will make choosing your perfect graphics display system more challenging than ever. The good news is that the state of the art has never looked so promising. □

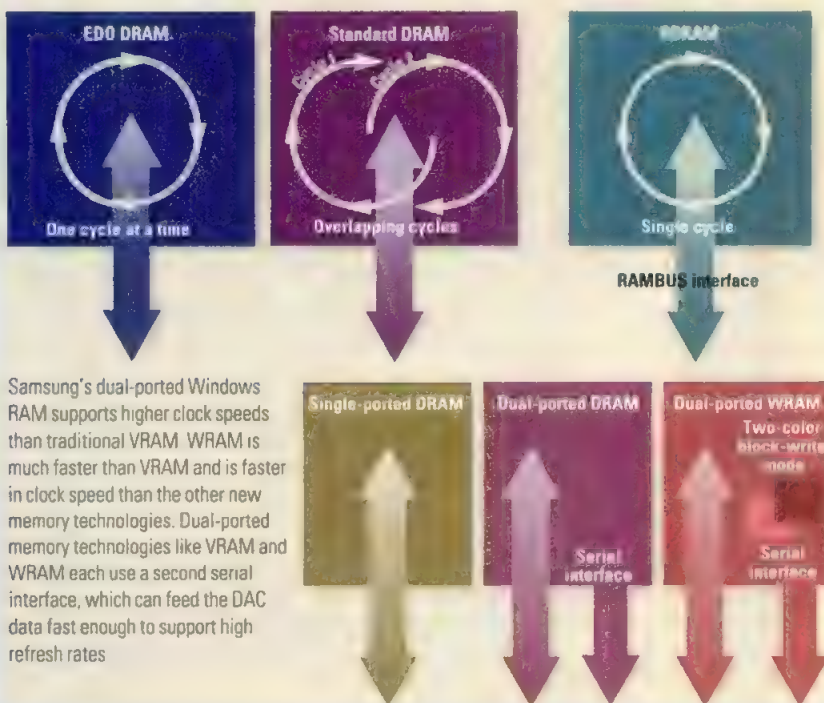
MEMORY ARCHITECTURE

More ideas, more choices

Extended data out (EDO) is a single-cycle memory type that achieves more efficient operation by holding onto the

data (outside the CAS cycle), so the data remains valid longer. This increases its bandwidth without widening the data bus.

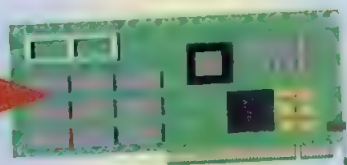
RDRAM replaces the conventional page-mode interface with a RAMBUS interface. It operates at 500MB per second over an 8-bit bus. This lets board makers improve card performance, as a higher-than-normal level of bandwidth is available (A normal 16-bit chip runs at about 40 megabits per second.)



Samsung's dual-ported Windows RAM supports higher clock speeds than traditional VRAM. WRAM is much faster than VRAM and is faster in clock speed than the other new memory technologies. Dual-ported memory technologies like VRAM and WRAM each use a second serial interface, which can feed the DAC data fast enough to support high refresh rates.

Integrated chip technologies

The days of trying to find one more bus slot for the final piece of your multimedia puzzle may end soon. Graphics card vendors are beginning to combine graphics acceleration, video-playback interpolation, the RAMDAC, and 16-bit audio all into one graphics card.



Inside the Perfect Hard Disk

The perfect hard disk is one element of a perfect storage subsystem configured for maximum performance.

By Leon Erlanger

The perfect hard disk is big enough to hold all your files and fast enough to help you run applications smoothly. Size is a characteristic of the drive itself, but hard disk performance also depends on other factors, such as the system data bus, drive controller, caching, and operating system.

BIGGER IS BETTER

If you're an entry-level user running Windows 3.1 with an eye on the upcoming Microsoft Windows 95, don't even consider purchasing a system with a hard disk that holds less than 720MB. Today's Windows applications take up 10MB or more each, and data files are bigger than ever now that fonts, graphics, sound, and sometimes even video have worked their way into all kinds of mainstream business documents. Windows 95 promises to up the ante even more, taking up 40MB on its own and promising 32-bit multithreaded applications with more multimedia than ever before. With hard disks selling for as low as 40 cents per megabyte, there's no excuse for skimping on drive storage.

For the typical home and business user, we recommend 1GB. Power users should consider anywhere from 1.6GB to 2GB. For a network file server, you shouldn't consider less than 2GB of storage, configured as a pair of mirrored 2GB disks. Mirroring, also called RAID Level 1, saves two identical sets of data on two sets of hard disks to prevent data loss from disk failure.

RAID stands for *Redundant Array of Inexpensive Disks* and defines six possible ways of configuring two or more drives so

that they appear to the system as a single hard disk. If your file server will require more than 4GB, you may want to consider a RAID Level 5 setup, which stripes, or distributes, blocks of data and parity information across three or more drives in such a way that the failure of one disk will not result in the loss of any data. RAID 5 tends to perform well with transaction-processing applications, which is why our perfect application server is also configured as a RAID 5 device. RAID 5 requires expensive hardware and a RAID controller with its own dedicated processor. Most RAID systems also have redundant power supplies and other components that provide further protection but add to their cost. The four other RAID configurations—RAID 0, RAID 2, RAID 3, and RAID 4—are not in widespread use.

Laptops now offer hard disks as large as 770MB (sometimes expressed as 810 million bytes). If you use your laptop as a secondary system for the road only, then 340MB may serve you adequately. But if you use your laptop regularly, then 520MB is the minimum you should consider. For extra storage, some laptops offer removable 2.5-inch drives; others offer PCMCIA Type III slots, which let you plug in PCMCIA hard disks. Currently, you can find PCMCIA disks that hold up to 260MB, but at \$599 for that size drive, they are priced significantly higher than standard hard disks.

SIZE ISN'T EVERYTHING

After size the next concern is performance. These days, hard disks for desktop

FILE-SERVER CONFIGURATION:

Fast SCSI-2 or Ultra SCSI

SCSI can easily handle simultaneous reads and writes and can reorganize pending requests for maximum efficiency. It also lets you daisy-chain up to seven peripherals on one SCSI controller.

ASPI compatibility

The ASPI (Advanced SCSI Programming Interface) standard, supported by many SCSI-2 peripheral vendors, simplifies the configuration of SCSI devices.

PCI or VESA local-bus SCSI-2 adapter

Like Enhanced IDE, SCSI-2 requires a bus that can sustain its fast throughput.

At least 2GB mirrored disk configuration

Mirroring stores identical sets of data on two separate hard disks to provide security in the case of a drive failure.

SCAM compatibility

SCAM (SCSI Configuration AutoMatically) is part of the Intel/Microsoft Plug and Play specification. A SCAM-compatible SCSI adapter automatically identifies and configures SCAM-compatible hard disks.



The PERFECT HARD DISK

DESKTOP SOLUTION:

Enhanced IDE (also called Fast ATA)

E-IDE drives are about \$30 to \$100 cheaper than SCSI-2 drives, yet for most standalone desktop users they perform just as well as their SCSI-2 counterparts. E-IDE drives also connect directly to IDE connectors found on the motherboards of most PCs and support disk sizes up to 8.4GB.

Secondary IDE connector

For tape drives and CD-ROM drives.

Primary IDE connector

For hard disks

Capacity and performance are essential for the desktop user. Maintaining data integrity via disk mirroring or a disk array is just as important for file servers and application servers.

Storage capacity: depends on user

- 720MB for the entry-level user
- 1GB for the average business user
- 1.6GB to 2GB for the power user

25MB intelligent segmented look-ahead buffer

A look-ahead buffer loads the entire sector containing the requested data into on-board memory. A segmented buffer holds several reads and adjacent data. An adaptive segmented look-ahead buffer intelligently varies the size of segments.

CD-ROM drive

E-IDE accepts up to three other devices, like CD-ROM and tape drives, that conform to the ATAPI standard.

Local-bus controller

PCI and the VESA local-bus configurations provide enough bandwidth to support E-IDE and Fast ATA's fast throughput. An EISA configuration will also suffice, but an ISA controller will create a performance bottleneck.

3.5-inch size, 1-inch height

Smaller size leaves more free space for other bays to accommodate bulky devices like CD-ROM drives.

2MB SmartDrive cache

SmartDrive comes with Windows 3.1 and MS-DOS 6.0, provides excellent performance, and is optimized for a 2MB configuration.

Fast burst data transfer rate

Enhanced IDE, Fast ATA, and Fast ATA-2 allow for fast burst transfer rates (11.1MB to 16.6MB per second), important for the performance of most business applications.

Fast access time (12 to 18 ms)

Fast access times are important for applications such as databases, which perform frequent reads and writes. Access times quoted in ads are often really seek times.

APPLICATION SERVER: RAID 5

A RAID (Redundant Array of Inexpensive Disks) 5 configuration stripes data and parity information across several drives, resulting in better performance and protection for mission-critical client/server applications. For uninterrupted access, look for features like dual power supplies and "hot swapping," which reconstructs data on the fly when you replace a failed disk with a new one. Application servers should use Fast SCSI-2, Fast-Wide SCSI-2, or Ultra SCSI adapters and the PCI or VESA local bus.



HOW A HARD DISK WORKS

A hard disk reads, writes, and stores data by changing the polarity of magnetic particles on the surface of spinning platters.

1 A **software application** requests a block of data through the operating system's API.

2 A **disk caching utility** intercepts the request to see if the data is stored in system memory devoted to the disk cache. If the data is there, it is copied to the application's buffer. If not, the request is sent to the hard disk's controller.

3 The hard disk controller checks the disk's **on-board buffer** memory to determine if the data is stored there. If it is, the data is sent back through the hard disk adapter to the application's buffer.

4 If the data is not stored in the hard disk buffer, the controller activates the hard disk's **head actuator**.

5 The head actuator moves the **read/write heads** across the platters to the destination track.

6 The **spindle** connected to the drive motor rotates the drive platters to help bring the requested data under the read/write heads.

7 The read/write heads either write data to the platters by changing the magnetic polarity of the particles on the surface or read data by detecting changes in polarity.

8 The file system (FAT in DOS, NTFS in NT, HPFS in OS/2) keeps a record of clusters used by each file.

systems don't differ radically in performance. Other factors like caching and the system bus affect hard disk performance more dramatically.

When shopping for a hard disk, you should check out some disk specifications, however. The first three described below indicate how long it takes the hard disk to position its heads to transfer a chunk of data. Applications that perform frequent random reads and writes are affected most by these specs.

Average seek time defines the average time the hard disk takes to move its read/write heads over the platters to a requested track. Seek times tend to decrease as you grow in disk capacity. Expect to see seek times of 10 to 12 milliseconds in 540MB drives, 8 to 10 ms for drives that are 730MB or larger.

Average latency specifies the time the drive takes to spin the platters until the

appropriate portions of the track are spinning under the heads. Expect to see latency times of 5.6 ms for 540MB to 1GB hard disks, and 4.2 ms for disks larger than 1GB.

Average access time is the number that results from adding average seek time and average latency, and it typically represents the amount of time it takes a hard disk to find a chunk of data. Expect 12.2-ms to 18-ms access times.

Keep in mind that most ads in computer magazines quote seek times, even when they claim to be quoting access times.

Data transfer rate, also called *throughput*, specifies the rate at which data is read from or written to the drive once the heads are positioned. Applications that mostly read and write sequentially—including most business and graphic arts applications—are the ones most affected by the data transfer rate. You may see per-

formance quotes given in megabytes per second (MBps) or megabits per second (Mbps). There are several different categories:

Burst data transfer rate, sometimes called *external transfer rate*, specifies the rate at which data is read from the drive buffer, which is a chunk of memory on the drive that captures disk reads and writes for faster access. Today's Enhanced IDE and Fast ATA drives typically have maximum burst data transfer rates of 11.1 to 16.6 megabytes per second. SCSI-2 drives have maximum burst rates from 10 to 40 MBps.

A maximum or minimum **sustained transfer rate**, also called *internal transfer rate*, reflects performance when the disk buffer is not being used—say, when you're downloading a very large graphics or video file. The internal transfer rate is greatly dependent on the drive's *spindle*

The Perfect Hard Disk

speed (also called *rotational speed*), which defines how fast the platters of a hard disk spin. Spindle speed is measured in revolutions per minute (rpm). Expect to see 5,400 rpm for disks of 540MB to 1GB and 7,200 rpm for disks above 1GB.

A FAST BUS

Fast throughput must be supported by a fast and wide data bus that doesn't create a bottleneck as the data makes its way to memory or the CPU. The 16-bit ISA bus, which has been the standard expansion bus in most PC-compatible systems for more than seven years, has a maximum throughput of 8.3 MBps (and in practice doesn't achieve more than about 3 MBps). This rate would throttle the burst throughput of today's fast Enhanced IDE, Fast ATA, and Fast SCSI-2 drives. Look for a local-bus configuration, which allows up to 132-MBps throughput—more than enough to support today's fast drives.

There are two types of local bus configurations: *VESA local bus*, which can be found in many 486 systems, and *PCI*, which is found in most Pentium systems and is quickly taking over as the local bus of choice.

Some older systems, particularly file servers, have EISA buses, which support a throughput of 33 MBps—also enough for most of today's fast hard disks.

If your system has an IDE connector on the motherboard, you may want to make sure the connector is on the PCI or local bus. If it's on a slower bus and your system has local-bus slots, consider purchasing a separate PCI or VL paddle card, which sells for under \$30.

YOU SAY E-IDE, I SAY FAST ATA

When it comes to choosing a drive interface, things begin to get confusing. Two years ago you had two clear choices: an IDE drive (also known as ATA) or a SCSI drive. IDE drives offered desktop users capacities up to 528MB, low pricing, good performance, and easy installation. SCSI drives were more expensive than IDE units and more difficult to install, but they offered capacities greater than 528MB, performed better than IDE drives in network file server configurations, and allowed you to add up to six other devices to the same SCSI bus the



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drive was attached to. Today the picture has muddled considerably but has more positive benefits for the user.

Enhanced IDE (E-IDE), a newer standard developed by Western Digital to replace IDE, is the best solution for most desktop users. Enhanced IDE hard disks cost from \$30 to \$100 less than SCSI hard disks and perform as well as SCSI drives in single-user applications. They connect directly to the motherboard in most newer systems, so there's no need to purchase a separate adapter card. Enhanced IDE also boasts four advantages over the old IDE:

- More storage capacity. While the former IDE standard did not allow drives over 528MB, the new Enhanced IDE standard allows up to 8.4GB per drive.
- More peripherals. The Enhanced IDE standard allows up to four E-IDE devices per system. Older IDE systems offered only one IDE connector on the motherboard, to which you could connect up to two hard disks.

Enhanced IDE systems generally offer two connectors, each of which can take two devices. The primary connector, or channel, is usually a local-bus configuration that makes the fast transfer rates of today's Enhanced IDE hard disks possible. The secondary channel is usually an ISA configuration with slower throughput for other peripherals.

- Other peripherals. The old IDE was simply a standard for hard disks. Enhanced IDE has expanded on the old standard to allow for ATAPI (AT Attachment Packet Interface)-compatible CD-ROM drives and tape drives. ATAPI CD-ROM drives have been available for several months and show performance equivalent to SCSI CD-ROM drives in single-user configurations.

Since today's CD-ROM drives have maximum throughputs of only 900 kilobytes per second, they can (and should) be attached to the secondary IDE controller. Attach them to the primary controller and the performance of your E-IDE hard disk may decrease, since many IDE controllers use the fastest speed common to the two peripherals on the bus. ATAPI tape drives had still not appeared on the market as of this writing but are expected in the second half of 1995.

- Better performance. Older IDE drives had maximum burst data transfer rates of 3 MBps. Enhanced IDE drives support several new host transfer standards defined by the Small Form Factor Committee, which develops standards for the storage industry.

These faster standards include *PIO (Programmed Input/Output) Mode 3* and the more recent *PIO Mode 4*, which support data transfer rates of 11.1 MBps and 16.6 MBps, respectively. PIO defines a standard in which the system's CPU is involved in every data transfer between the hard disk and main memory. *Multword Mode 1 DMA (Direct Memory Access)* and the more recent *Multword Mode 2 DMA* support burst rates of 13.3 MBps and 16.6 MBps, respectively; they define standards for transferring data directly

from the hard disk to main memory.

Keep in mind that to get the full benefits of any one of these four standards, both your drive and your system BIOS must be compatible not only with Enhanced IDE but with whatever PIO or Multiword DMA standard you seek. The reason is that the Enhanced IDE standard is ambiguous: Western Digital allows vendors to label their systems and drives Enhanced IDE even if they conform to only a subset of that definition.

If you have a system with an Enhanced IDE BIOS, it will probably support hard disks with capacities over 528MB as well as ATAPI peripherals. However, it may not support PIO Mode 4 and Multiword Mode 2 DMA transfer rates. Check with the system vendor or look in your manual to see whether your system

Hard Disk Standards Compared

	Enhanced IDE	SCSI-2
■ YES ■ NO		
Intended use	Individual desktops.	File servers, application servers, power desktop systems that require maximum expandability.
Maximum hard disk size	8.4GB	8.4GB
Burst data-transfer rate	PIO Mode 3 (11.1 MBps), PIO Mode 4 (16.6 MBps), Multword Mode 1 DMA (13.3 MBps), Multword Mode 2 DMA (16.6 MBps).	Fast SCSI-2 (10 MBps), Fast/Wide SCSI (20 MBps), Ultra SCSI (20-40 MBps).
Devices supported	Internal hard disks, CD-ROM drives, tape drives.	Internal and external hard disks; CD-R, CD-ROM, DAT, and tape drives; scanners; other peripherals.
Maximum number of devices	Four: two on the primary connector, two on the secondary connector.	Usually eight, including the SCSI adapter. Some SCSI adapters can attach more than seven devices.
Best bus configuration	VL-Bus or PCI.	VL-Bus or PCI.
Installation	E-IDE systems require the user to plug the drive into the primary E-IDE connector on the motherboard; older systems may need an E-IDE paddle card. Different brands of hard disks may not work with each other. The user may have to reset jumpers if more than one drive is installed.	Usually requires a SCSI adapter card, though some systems have their own SCSI support. User may have to reset jumpers to assign SCSI IDs and termination.
Windows 95 support	■	■
Other names for this technology	Fast ATA (for hard disks with PIO Mode 3 and Multword Mode 1 DMA transfers) or Fast ATA-2 (for hard disks with PIO Mode 4 and Multword Mode 2 DMA transfers).	None

The Perfect Hard Disk

is able to support higher transfer rates.

Because of this ambiguity, Seagate and Quantum have chosen not to apply the Enhanced IDE label to the drives they manufacture. Instead, they use the term *Fast ATA* for high-speed drives that support PIO Mode 3 and Multiword Mode 1 DMA data transfers and *Fast ATA-2* for drives that support PIO Mode 4 and Multiword Mode 2 DMA data transfers. These drives also work with the Enhanced IDE BIOSes that support those transfer rates.

On older systems, you can still get the benefits of Enhanced IDE by purchasing your hard disk with an Enhanced IDE paddle card and installing them in your system. If you connect the disk to your motherboard's IDE connector, the disk may work—but you may not get more than 528MB out of it, and you are unlikely to get Enhanced IDE performance.

SCSI FOR LANS

If you're looking for a hard disk for your file server, SCSI is the still right solution. SCSI is a secondary bus that has its own intelligence and is geared specially towards processing simultaneous data requests. SCSI features such as *tag command queuing* and *elevator seeking* take in multiple requests and reorder them so that they can be processed with the minimal amount of head movement and drive rotation—and thus yield the best performance.

Two SCSI standards exist today: SCSI-2 and Ultra SCSI. *SCSI-2* drives offer either Fast SCSI-2 transfer rates of 10 MBps using an 8-bit bus or Fast/Wide SCSI-2, which offers a transfer rate of 20 MBps using a 16-bit bus. A newer standard called *Ultra SCSI* boasts transfer rates of 20 MBps on an 8-bit bus and 40 MBps on a 16-bit bus. SCSI-3, a newer standard currently under development, adds to the SCSI-2 command set but doesn't offer a speed increase. All present standards are backward compatible: SCSI-2 and Ultra SCSI adapters will accept older SCSI devices.

Down the road, a standard called *fibre channel*, also currently under development, will boast transfer rates up to 100 MBps and will probably replace SCSI for high-end servers and RAID systems. The first fibre-channel products

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Benchmark Tests: The Perfect Hard Disk

What the Numbers Mean

Both the Disk WinMark 95 and Winstone 95 test results showed very little difference in performance between Fast SCSI-2 and Enhanced IDE (E-IDE) drive configurations. The Disk WinMark 95 tests heavily exercise the disk subsystem. On Disk WinMark 95, the average scores for the E-IDE and Fast SCSI-2 drives were within less than 1 percent of each other. Even the 24-point difference between the best SCSI-2 drive and best E-IDE drive came to less than 3 percent.

The Winstone 95 tests, which run real-world applications in order to measure the performance of all subsystems, offer a better way to gauge the impact of E-IDE drives versus SCSI-2 drives on day-to-day PC use. Here the scores were even closer: The average results for both drive types fell within one point of each other, as did their best results.

32-BIT DISK AND FILE ACCESS

32-bit disk access Both Microsoft Windows 3.1 and Windows for Workgroups 3.11 include a device driver that lets Windows apps perform data transfers in the CPU's protected mode rather than DOS's real mode (the default mode). But the manipulation of the file allocation table (FAT) still has to be done in real mode. Switching between real and protected mode is a time-consuming task that slows down performance.

32-bit file access Under 32-bit file access, SmartDrive's 16-bit cache is replaced with a 32-bit protected-mode cache, and FAT manipulation is done in protected mode.

Enabling 32-bit disk access alone had a negligible effect on Disk WinMark 95 performance. Enabling 32-bit file access alone caused performance to increase by more than 47 percent. When 32-bit file and disk access were both enabled, Disk WinMark 95 performance was more than 68 percent better

32-Bit Disk Access and 32-Bit File Access

	Default (no 32-bit access)	32-bit disk access enabled	32-bit file access enabled	32-bit disk and file access enabled
	Score	Score	Performance increase over default (%)	Performance increase over default (%)
WINSTONE 95				
Average for E-IDE drives	126	126	0.00	137
Average for SCSI-2 drives	127	126	-0.79	135
DISK WINMARK 95				
Average for E-IDE drives	490	495	1.02	789
Average for SCSI-2 drives	511	510	-0.20	755

should start to appear in late 1995.

To attach a SCSI hard disk you need a SCSI adapter, which sells for \$50 and up. SCSI gives you an additional advantage over Enhanced IDE that power users may also want: You can attach up to seven SCSI peripherals—including hard disks, tape drives, CD-ROM drives, magneto-optical drives, scanners, and more—to a SCSI single adapter. And while all En-

hanced IDE peripherals are internal configurations, SCSI lets you attach external devices.

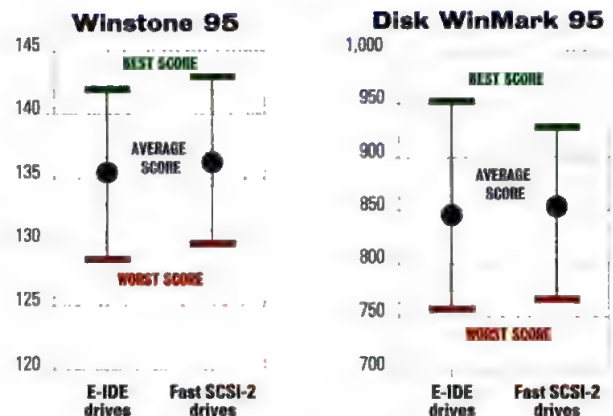
To get the best SCSI performance, make sure that you get a local-bus SCSI adapter. High-end desktop users may also want to consider SCSI if they intend to make frequent use of the true multitasking capabilities of Windows NT, OS/2 Warp, and Unix. For example,

SCSI makes it easier to download a large file and work on a spreadsheet at the same time.

INSTALLATION: A MIXED BAG

IDE installation used to be easy and SCSI installation used to be difficult. However, SCSI has become a lot easier due to excellent installation utilities like Corel's CorelSCSI and Adaptec's EasySCSI.

ENHANCED IDE VS. SCSI



than under Windows' default configuration, in which neither was enabled.

How We Tested

Our test-bed consisted of two Micron Millennia P90s and two HP Vectra 5/90s with 90-MHz Pentium CPUs and 16MB DRAM. SCSI drives were tested with write cache enabled on the disk, using Adaptec 2940 and Future Domain TMC-3260 PCI host adapters. E-IDE drives were tested in their fastest Programmed I/O mode (Mode 3 or Mode 4) using the Intel 82371FB controller on the Micron Triton motherboards and the CMD controller on the HP motherboard. Both test-beds were running MS-DOS 6.22 and Windows for Workgroups 3.11. For the E-IDE vs. SCSI-2 comparison tests, both had 32-bit file and disk access enabled, with 4MB V-CACHE. The SCSI-2 hard disks we tested were the Seagate ST31200N Quantum Empire SCSI 1080, IBM DPES-31080, and Conner CFP1080S. The E-IDE hard disks we tested were the Seagate ST31220A, IBM DPEA-31080, Conner CFA1275A, and Western Digital Caviar 31000.

Winstone 95 measures the time a PC takes to execute a set of scripts that exercise 13 of the best-selling Windows 3.1 applications. Winstone weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score (relative to the performance of a Compaq 386DX/25 Compaq Deskpro/M with 4MB RAM, whose score is defined as 10).

Disk WinMark 95, a subset of WinBench 95, tests the performance of a PC's disk subsystem under Windows 3.1 by using a variety of files and directories in a blend based upon a profile of disk usage under the Winstone 95 application scripts.—*Analysis written by Denis Tom*

the speed trap.



Everyone loves speed and performance.

The only problem is that when it comes to drives, some people confuse one for the other.

Some think seek time or the latest host transfer buzzwords like Mode 4 PIO represent a drive's performance. In actuality, a drive's performance is the combination of media rates, buffer sizes and host rates, as well as seek and spin times. So it hardly matters how impressive a drive's individual speed specs are if the other factors hamper its overall performance.

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Enhanced IDE, meanwhile, is a mixed bag. If you're installing one drive in an Enhanced IDE-compatible system, it should be quite easy. However, if you're installing a second Enhanced IDE drive, you may have difficulty getting the two drives to work together since some brands of Enhanced IDE drives won't work on the same bus as another brand. You'll have to designate one drive as a master and one as a slave, which means messing with jumpers.

If you're adding an Enhanced IDE drive to an older IDE system, installation will probably be more complicated. You may find that you suffer a performance penalty by attaching an Enhanced IDE drive directly to an old motherboard, and you may have trouble getting more than 528MB from the second disk. In that case you'll have to purchase a separate Enhanced IDE paddle card.

SCSI installation requires that you install a SCSI adapter, which may mean dealing with IRQ and I/O conflicts much like with any other add-in card. Once you have the SCSI adapter installed, attaching one peripheral should be easy, but attaching more than one means dealing with SCSI termination and ID issues. Again, CorelSCSI and Adaptec's EasySCSI have made the process much easier, but it is by no means foolproof.

PLUG AND PLAY AND WINDOWS 95

Fortunately help is just around the corner. It's called Plug and Play, and it will be a standard feature of Windows 95. When you purchase any peripheral, make sure it is compatible with the Windows 95 Plug and Play spec. In the case of SCSI adapters and peripherals, this means compatibility with SCAM (SCSI Configuration AutoMatically) a subset of the Plug and Play standard that should make configuration of SCAM-compatible SCSI adapters and peripherals automatic: no messing with jumpers and no knowledge of SCSI IDs, termination, IRQs, DMAs or I/O addresses required. In most cases drivers will be loaded automatically by the operating system. Plug and Play even helps you install your legacy peripherals, but that process is by no means automatic (see "Effortless Upgrades," *PC Magazine*, May 16, 1995, for more information on Plug and Play).

BUFFERS AND CACHES

No matter how fast your hard disk is, RAM is thousands of times faster. Most hard disks and computer systems take advantage of its speed by attempting to predict reads and writes to the hard disk and storing that information in RAM.

A *hardware cache* is a chunk of memory found on some high-end hard disk controllers. A *software cache* is a chunk of your system's main memory reserved for disk caching and controlled by a software utility like Windows' SmartDrive. Both work pretty much the same way. When it's time for a disk read, the system screens the request first to see if the data is in the cache. If it is, that's called a *hit*, and the cache forwards the information to the program without involving the disk. This is called *read-through caching*, and it can increase performance dramatically. *Writeback caching* stores writes in memory, then writes them to the disk when the disk becomes idle. Writeback caching can also speed performance, but there's a risk involved: If you have a power interruption before the data is written to the disk, it's goodbye data! That's why it's important to have an uninterruptible power supply (UPS).

In most cases except for high-end servers, software caches tend to be faster than hardware caches, since data transfer is faster across the memory bus than across the data bus.

Allocating memory for cache is a delicate balancing process. You want to provide enough cache memory to ensure lots of hits, but not leave so little system memory that you end up slowing down other system functions. We recommend that for the best performance, you should limit cache size to one-fourth of your system memory. If you have 8MB in your system, set up a 2MB cache. If you have 16MB, go for 4MB. Keep in mind, however, that SmartDrive, a capable cache program that comes with Windows 3.1 and MS-DOS 6.0, is optimized for a 2MB cache, so you may not get a performance improvement if you allocate more than 2MB.

Microsoft Windows for Workgroups 3.11 provides a new feature called *32-bit file access*, which replaces SmartDrive's 16-bit cache with a 32-bit protected-mode cache and allows applications running under Windows to manipulate the DOS file allocation table (FAT) in protected mode rather than the usual DOS real mode. Our tests show that enabling 32-bit file access can improve performance by as much as 61 percent.

By default, Windows 3.11 is not running 32-bit file access. To enable it you have to open the Control Panel, double-click on the 386 Enhanced icon, click on Virtual Memory, then on Change, then on the box labeled "32-bit File Access" until "X" appears, and then choose OK.

Don't confuse 32-bit file access with *32-bit disk access*. A feature found in both Windows 3.1 and Windows for Workgroups 3.11, 32-bit disk access lets Windows applications perform disk data transfers under protected mode. Our tests showed that enabling 32-bit disk access alone does not result in any performance increase, but when it is combined with 32-bit file access, performance increases by more than 68 percent over a default configuration in which neither 32-bit disk nor 32-bit file access is enabled. This is because under 32-bit disk access alone, the file allocation table (FAT) has to be manipulated in real mode, and switching between real and protected mode slows down performance.

Keep in mind that some IDE drives won't work with 32-bit disk access enabled. Many Enhanced IDE drive vendors bundle special drivers with their hard disk products to solve this problem, but if you are buying a complete PC rather than just a hard disk, you usually won't find them packaged with your system.

Buffers are memory chips found on most hard disk units. Every time data is requested from the hard disk, a *lookahead buffer* writes data from adjacent sectors to on-board memory in the expectation that it will be requested next (usually the case in sequential reads). *Segmented lookahead buffers* divide the buffer RAM into small-

In most cases, software caches tend to be faster than hardware caches, since data transfer is faster across the memory bus than the data bus.

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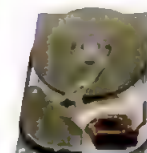
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The Perfect Hard Disk

er buffers for storing more than one read at a time, and *adaptive segmented look-ahead buffers*, considered the most effective, can adjust the number and size of buffer segments to increase performance. Disk buffers range from 128K to 512K and tend to be larger on large hard disks.

BUYING THE PERFECT HARD DISK

If you're buying a new system, your hard disk will come as part of the PC. If you are upgrading an older system, things are a little more complicated. If your PC has an obsolete ST-506 or ESDI (enhanced small

of disk capacity: unformatted and formatted. In a DOS/Windows environment, formatted capacity is about 5 percent less than unformatted and more closely represents the amount of storage you can expect. Also keep in mind that some vendors give megabyte ratings based on a 1,024-byte kilobyte, while others base the rating on a 1,000-byte kilobyte. And remember, if you see a spec for access time

quoted in a magazine ad, the vendor is probably really quoting seek time.

Warranties vary from 90 days to 5 years. Most mail-order disks come with a 30-day money-back guarantee, but watch out for restocking charges.

Today's hard disks are very reliable devices. Armed with the right information, you should have no trouble finding the perfect hard disk for your needs. □

*Keep in mind that if
you see a spec for access
time quoted in a
magazine ad, the
vendor is probably really
quoting seek time.*

device interface) adapter, your best bet is a new Enhanced IDE hard disk with an Enhanced IDE paddle card. If you have an older IDE system, you probably want to replace your old IDE drive with a bigger and better Enhanced IDE drive, given today's bargain drive prices. If you opt to keep your original IDE drive, your best bet is to purchase a new drive with an Enhanced IDE paddle card and connect both disks to the new card. But if your older system has no local-bus slots, you may not achieve E-IDE's fast transfer rates.

Hard disks are available from computer superstores, mail-order houses, and other sources. The top-selling hard disk vendors are Conner Peripherals, Maxtor, Quantum, Seagate, and Western Digital, though you'll also find high-quality hard disks from Digital Equipment Corp., Fujitsu, Hewlett-Packard, IBM, and Toshiba.

If you're buying a new hard disk, look for a complete drive kit, which includes mounting hardware and cables. If you are replacing an existing disk or adding a second IDE disk, you may be able to get away with purchasing just the bare drive, which sells for \$20 to \$100 less.

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Inside the Perfect Multimedia Add-Ons

If the only thing keeping your just-fine PC from being a perfect PC is multimedia capabilities, look no further.

By *Jamie M. Bsales*

Chances are, if you haven't already joined the millions who have added sound and motion video to their personal computing experience, you're thinking of it. There are now nearly 10,000 software titles that assume you have a CD-ROM drive, sound card, and speakers. Many mainstream applications such as word processors and spreadsheets can still be loaded from traditional floppies, but offer easier installation and exclusive features for users of multimedia-equipped PCs. And the use of sound and video promises to become even more pervasive as business uses such as videoconferencing and PC-based training come of age.

There are three paths you can choose to upgrade a deaf and dumb PC, each of which offers a different amount of resistance:

- **Buy a multimedia PC.** By far the easiest way to upgrade is to buy a new PC that comes equipped with a CD-ROM drive, sound board, and speakers—usually for only a few hundred dollars more than a PC without multimedia hardware. This ensures that all the pieces work together right out of the box. But this approach assumes that you're willing to scrap your whole system, and you're also not assured that the components offered will suit your individual needs.

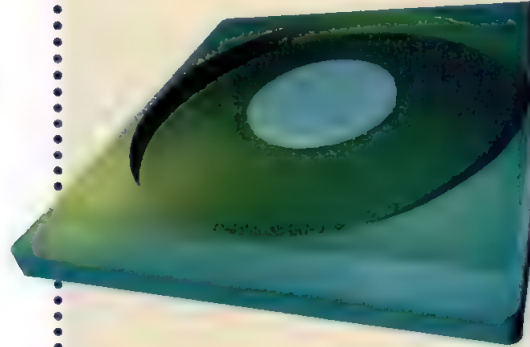
- **Buy a multimedia upgrade kit.** Kit vendors bundle everything you'll need—CD-ROM drive, sound card, speakers, cables, and even software titles—into one box, for prices starting at \$299. Here again, though,

you may not find the exact mix of components to match your needs. In our review of upgrade kits ("Moving Up to Multimedia," October 25, 1994), we found that in most instances you'll want to scrap the provided tinny-sounding speakers and buy your own—a hidden cost. Also, the dozen (or more) multimedia titles included with many kits are often mediocre. Worse, while kit vendors have made easier installation a priority, users are unable to get both the CD drive and sound card functioning properly with their systems.

- **Buy separate components.** Doing so means you'll have to figure out the resource settings (IRQ, DMA, I/O, and memory addresses) that each device can accommodate and configure all your components so there are no conflicts if you can. Microsoft Windows 95 and its Plug and Play specification promise to alleviate some installation hassles (see the section on Plug and Play in this piece). But until your PC and all the components you buy match the spec, you'll still have some juggling to do. You'll also probably spend more money for separate components than for a kit. In return, you'll be able to choose each piece of your multimedia system to match your needs and purposes.

CD-ROM DRIVES

Over the past year the industry has moved away from double-speed CD-ROM drives to quadruple-speed units as the standard. The speed rating reflects the data-transfer rate of a drive; the first CD-ROM



Caddy or caddyless?

Some drives require that disks be placed in \$5 plastic caddies, which protect your CDs from fingerprints and scratches. If you do a lot of disk-swapping or share disks with others, a caddy-based drive is a good idea



Headphone jack

You'll want a drive with a headphone connector ($\frac{1}{8}$ -inch miniplug) for private listening.

Portable drives

For maximum performance on the road, connect an external SCSI drive to your laptop via a PCMCIA SCSI adapter. Other lightweight drives connect to any PC via the parallel port, but performance is hampered by the slow parallel connection.

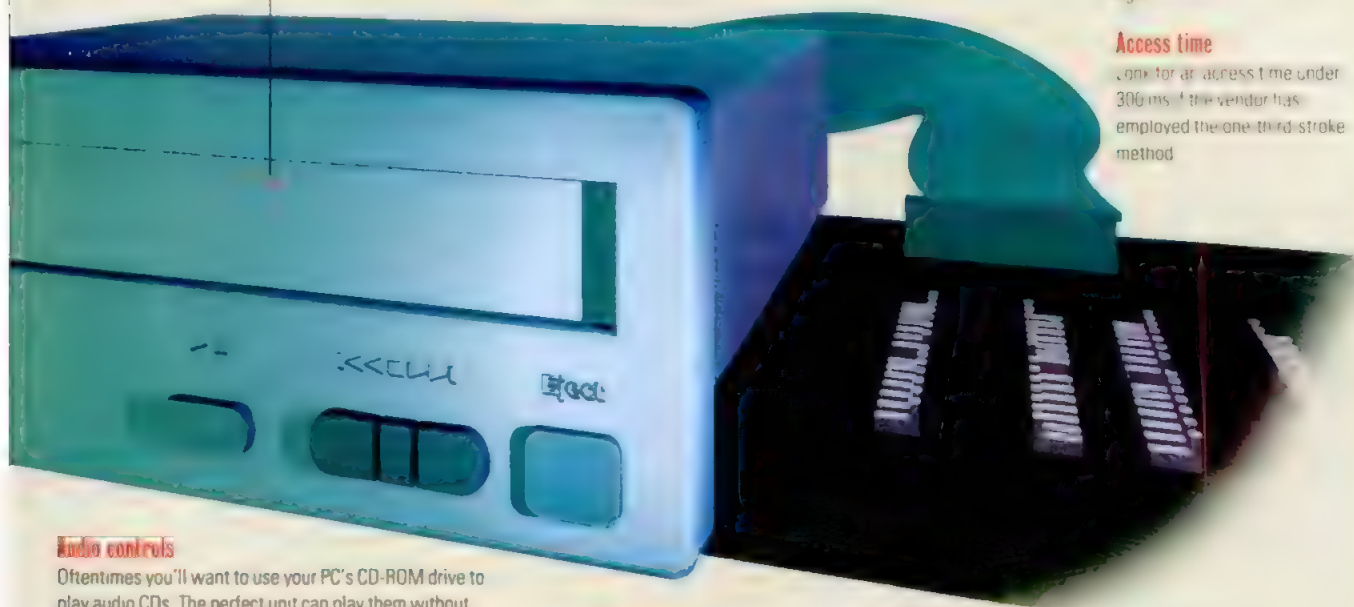


The PERFECT CD-ROM DRIVE

The perfect CD-ROM drive delivers performance robust enough to handle the audio- and video-intensive multimedia applications that are becoming more commonplace. We recommend a unit with a quadruple-speed drive mechanism and an efficient 250K buffer. **Price: \$350.**

Dust-cover door

This door keeps dust from entering the drive's internals, keeping the mechanism and laser lens clean. Better drives sport an inner door as well.

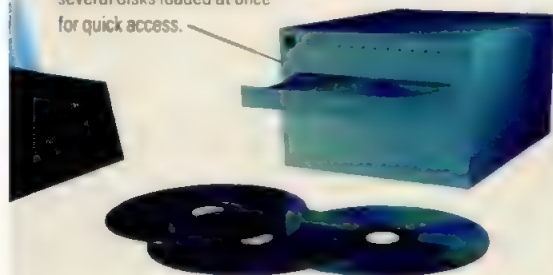


Audio controls

Oftentimes you'll want to use your PC's CD-ROM drive to play audio CDs. The perfect unit can play them without software and offers a volume control, an LCD read-out to indicate the track currently playing, a play/pause button and last track/next track buttons.

Changer

A CD changer lets you keep several disks loaded at once for quick access.



CD-ROM connectors



Internal IDE connector

Internal SCSI connector

Ref Book Audio connector

External parallel connector

External SCSI connector

RCA (phono) jacks

Quadruple-speed

For smooth video playback, a high data transfer rate is important. Quad-speed drives boast a rate of 600 KBps, twice that of the double-speed units that were the standard a year ago.

Access time

Look for an access time under 300 ms. If the vendor has employed the one-third-stroke method.

Eject button

Motorized eject makes using the drive a little easier. Make sure the eject button is easily accessible. With many drives it's difficult to see the close button when the drawer is open.

Driver

You don't want a unit's driver to be a memory hog. A space-efficient driver takes up from 20K to 60K of conventional memory, much more than that and you could have problems running DOS games.

E-IDE interface

Proprietary connectors have given way to standard interfaces based on the ATAPI/IDE specification. This lets you plug the drive directly into an IDE connector on your PC's motherboard.

Internal or external?

Internal drives usually cost less than a comparable external drive. But if you're out of drive bays or plan on shutting the drive to different PCs, an external unit is the way to go.

SCSI interface

At the high end of the market, SCSI is the interface of choice. Though we observed no performance differences between similar SCSI and E-IDE drives, a SCSI unit makes sense for drives that will be used in a file server or on a network.

Plug and Play

Drives that adhere to this new specification should be easier to configure if your operating system offers Plug and Play capabilities.

World-class overheads at astonishing speed and an equally amazing price.

Business Color

COLOR PPM

Phaser 340

Color Laser

COST PER PAGE

Phaser 340

Color Laser

PRINTER PRICE

Phaser 340

Color Laser

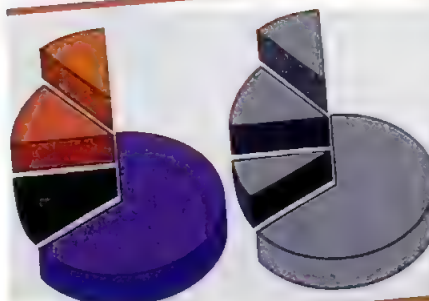
Tektronix

Text and spreadsheets can be printed from PCs, Macs and workstations. Or connect directly to virtually any network.

Sales-O-Gram

To: All Sales Representatives
From: Kenton O'Keefe
Sales Manager
Subject: Persuasive power of color presentation

- Color increases ad readership 39%
- Color ad increases sales 42%
- Color documents provide 70% time savings, 39% decrease in errors
- Color improves attention, comprehension, recall and recognition



We've seen that, in general, presentation is powerful. Let's look now at the benefits of presentation visuals.

Color is all around us in our everyday life. We probably don't think much about the color and how it affects us. But, imagine with all the lights the same color. How would the traffic light be? Color can produce a stronger response in the visual white.

For example, adding color to a map can increase ad readership 39% over black and white. A newspaper color ad can increase ad sales with the same as in black and white. Decision type documents experience 70% time savings and a 39% reduction in errors. Same documents in black and white.

Research shows that color improves attention, comprehension, recall and recognition and white.

Color improves recall and recognition performance compared to black and white.

% Greater Impact:	Color Visuals
Action	56
Retention	84
Agreement	13
Comprehension	19
Attention	
Perceptions	

[1] GARR Report No. 110.3A "Does Color Increase Advertising Readership?", Colvers Publishing Co.
[2] "Update on split run tests on sales effectiveness of BOP color ads #20", internal report of color versus black and white ads, 1988, Newspaper Association of America.

[3] From a study conducted by Company, Xerox Public Information, [Borges, et al., "Recall and Recognition and Children," Bulletin of

Color is color, unless it's

It's the business printer you've been waiting for. Office color that's so easy to use, reliable, and inexpensive, it's a practical office tool. It's the new Tektronix Phaser™340 color printer.

Speed? It's the world's fastest color printer at 4 color pages per minute. Cost? Full text pages on plain paper at 3¢ each. Color pages for 12¢ on your office paper. Simplicity? If you can load a stapler, you've mastered

Print vibrant, high-end color on office papers for less cost per page than low-end color. They'll snap to attention.

Connect faces and places with photorealistic quality. Welcome to the world of practical color!



brilliantly practical.

this machine. Reliability? Add 750 sheets of paper and let it run overnight. Now, that's robust. Cost? At \$4,995 there's nothing in its performance range that even comes close. Best of all, it's from Tektronix, a

Fortune 500 leader, that's been making world-class color printers for 13 years. **The Phaser 340 Color Printer.** So practical, it's brilliant.



CIRCLE 001 ON READER SERVICE CARD

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<http://www.tek.com/CPad1294>

How a CD-ROM Drive Works

Data is recorded in a clockwise spiral from the center out. The motor varies the disk's spin rate, so data goes by the laser at a constant speed.



drives (dubbed sin data at a rate of 15 second), the same quad-speed drives

Double-speed drives for the more price don't recommend in quad-speed a tremendous, and p from about \$950 or \$229. The technology ahead, and most mers are releasing higher throughput, tages for users of C for those who dow for now, we feel quad-speed drive i

In fact, in our ROM drives ("The ROM Drives," M speed drives in ge performance to ha second (fps) 320-b typical of today's cations. And while bogged down on c dropping hundred audio portions, the able to deliver sm all but our most rig fps Custom AVI R

In addition to characteristics pla CD-ROM perform a drive that offers drive's buffer is d stores data read fr sent along to the C lets the drive send short bursts, rat

CPU with a sl data. The buffi buffer must be data to the CP total buffer siz that will affect m tion playback. If too large, it will c buffer writes to th the drive will requi the CPU, taking p from other necess

Another consi controller interfac found negligible p between Enhance



NETWORKED CD-ROM

Our perfect networked CD-ROM device is a multitdrive tower server. **Price: \$5,700.**

Power supplies

Remove one of the hot-swappable power supplies and the other keeps the tower going

Internal cooling fan

Server tower

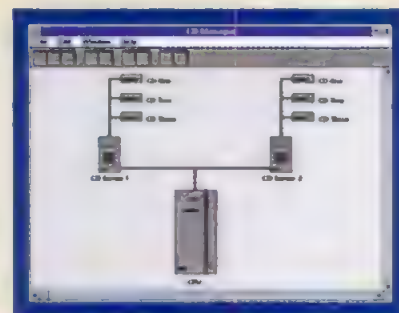
Earlier CD-ROM towers were hooked to a file server. But the new generation have their own CPUs and connect to the network to allow disk access even if the file server goes down

Swappable drive controller

Standard CD-ROM drives are each fitted with rails and a card that plugs into an ISA slot in the back of the tower. The drives are hot swappable, so you can change them on the fly

Fast SCSI-2 tower

These units typically place six to nine SCSI CD-ROM drives in a mini-tower case and give network users simultaneous access to all the disks that are loaded



Management software

Most units ship with software that makes it easy for the network administrator to manage access and set permissions. You can also use utilities included in the network operating system

Quad-speed drives

Quadruple-speed CD-ROM drives provide excellent performance even from video-intensive applications

Lockable door

CD-ROM connectors

- ISA card controller
- 50-pin SCSI
- Power connector
- DIP switch

CD-ROM drives hooked up to our standard tower-based, despite the claims to the contrary. In the end, interested parties in each camp. Enhanced IDE CD-ROM drives (also known as ATAPI drives) generally offer easier setup and will be the choice for most mainstream users (those with older IDE systems may need a paddle-board adapter). SCSI, meanwhile, offers more robust expansion capabilities: A SCSI adapter lets you daisy-chain seven devices off a single controller.

SCSI is also the right choice if you're

looking for an external or portable CD-ROM drive. If you want to take a CD-ROM drive on the road with your notebook, look for one that connects to your notebook via a PCMCIA SCSI adapter. Some portable drives connect through the inherently slow parallel port, whose throughput of 40KBps or so severely hampers performance. If your PC sports an Enhanced Parallel Port (EPP) or Extended Capabilities Port (ECP), though, you can count on twice the throughput and decent performance from the drive.

There are a handful of decisions you'll have to make to get the drive that suits your style. For starters, you'll have to choose between an internal or external drive. An external drive will cost from \$30 to \$100, but if you're short on drive bays or want to move a CD-ROM drive from one system to another easily, it's worth the premium. Note that an internal drive should provide a Red Book-compliant analog audio connector and a cable to connect to the Red Book audio connector on the sound card; an external drive

The PERFECT SOUND BOARD

A perfect sound board will provide noise-free CD-quality audio playback, as well as faithful recording. Price: \$230.

16-bit 44-KHz stereo sampling

To achieve CD-quality audio recording and playback, the card must take 44,100 16-bit samples every second.

SCSI or IDE connector

This built-in connector lets you hook your sound card to your CD-ROM drive.

General MIDI compatibility

This ensures that you get the intended instrument sounds when MIDI files are played.

4MB wavetable ROM

These on-board chips store 8MB of compressed instrument samples for MIDI playback.

Analog audio connector

Audio connectors

- Variable line-out connector
- Line-out connector
- Microphone jack
- Line-in connector

MIDI/joystick port

This allows you to hook up a MIDI instrument (such as a keyboard) or a game controller directly to the card.

Preamplifier

This component mixes various analog inputs (microphone, stereo system, and other sources).

Plug and Play

Boards are starting to appear that adhere to this spec, which will make installation under Microsoft Windows 95 easier.

Power amplifier

Most power amplifiers produce only a few watts of power and introduce noise and distortion, which means you'll want self-powered speakers.

Wavetable synthesizer

This chip reproduces sounds from samples activated by MIDI commands. Wavetable sounds are more realistic than the cheaper FM synthesis.

Sound Blaster compatibility

Many popular DOS games require Sound Blaster compatibility in order to reproduce their sound effects.

DSP chip

A digital signal processor can be programmed for any number of functions, from adding special sound effects to adding other functions such as a fax modem.

1MB of RAM

You'll want 1MB of RAM to hold sound samples downloaded from a hard disk.

Compression

Because there are so many standards for audio compression, the sound board should recognize them all.

should provide analog line-out RCA connectors, so you can run a cable to the line in the connector on your sound card. Either configuration lets you play audio CDs on your CD-ROM drive.

Some drives let you drop the CD-ROM disk right into the drawer, as you do with an audio CD player. Others require that disks be placed in plastic caddies. This protects your CDs from fingerprints and scratches, but you'll pay \$5 per caddy for the privilege. If you keep your CPU on its side, though, note that only a

few caddyless drives will operate this way. If you find yourself swapping disks often, consider investing in a multidisk unit. These drives keep several disks in a special caddy simultaneously, so you can quickly switch often-used titles. Internal units on the market can accommodate 3 disks; external multidisk drives on the market hold 6, 7, or even 18 CDs. Finally, double-check the footprint in conventional memory occupied by the unit's driver; more than 60K could interfere with DOS games.

PERFECT NETWORKED CD-ROM

Medium-size and larger companies are discovering the benefits of having CD-based data and shared applications online for all network users to access, and that calls for specialized equipment. There are two distinct types of networked drives: jukeboxes and towers.

Like an old Wurlitzer, CD jukeboxes pluck the desired title from a stash of dozens of disks. If you need to give network users quick access to CD-ROM-based applications, though, a CD

Only "MULTIMEDIA-READY" disc drives give you
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Multimedia applications demand higher capacity disc drives. You know that. But were you aware that very few drives actually give you the performance you need?

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The Decathlon 850 and Medalist 1080 deliver the performance required for near broadcast quality video on desktop PCs.



Both drives feature the Fast ATA-2 interface, which is 100% compatible with old IDE, yet up to 400% faster. So you can get the best in both value and performance.

For higher-end SCSI systems, Seagate's Hawk family offers 1 and 2 GB drives. Hawk drives feature Seagate's ASA II architecture to reduce processing overhead and provide superior multimedia performance.



So for the capacity and performance you need to run multimedia, demand Seagate's Multimedia-ready drives. For more information, see our home page at <http://www.seagate.com>, or call 408-438-8111.

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We've also added TriFlex/PCI Architecture, PCI Local Bus Graphics, and a host of other features you'll find in the chart to the right. And, naturally, we've made the new Compaq ProLine Plug and Play compliant. In short, the new ProLine gives you a whole new way to think about business computing. And there's no easier way to get your hands on one than by calling Compaq DirectPlus.*



THE NEW
COMPAQ PROLINE FAMILY

CHOOSE YOUR COMPAQ PROLINEA



Processor	486DX 2/66	Pentium 75MHz	Pentium 75MHz
Processor Upgradable	Yes	Yes	Yes
Std./Max. Memory	8MB/136MB	8MB/192MB	16MB/192MB
Hard Drive	420MB	420MB	720MB
Cache Internal	8KB	16KB	16KB
Cache External	256KB (optional)	256KB	256KB
Local Bus Graphics	PCI	PCI	PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	2MB/4MB
Compaq 150 Color Monitor	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	4	5
Drive Bays (Total)	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes
Software Preinstalled	MS-DOS* 6, MS-Windows* 3.1	MS-DOS 6, MS-Windows 3.1	MS-DOS 6, MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes
Warranty†	3-Year	3-Year	3-Year
Price*	\$1,949	\$2,319	\$3,119

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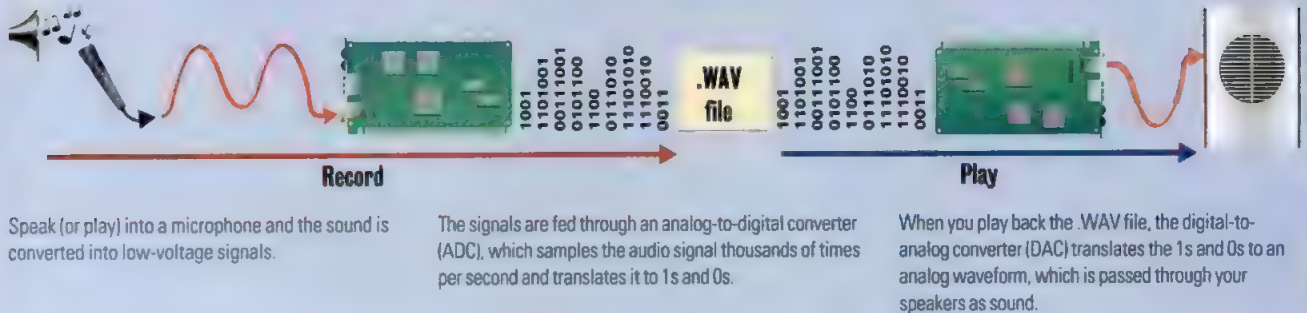


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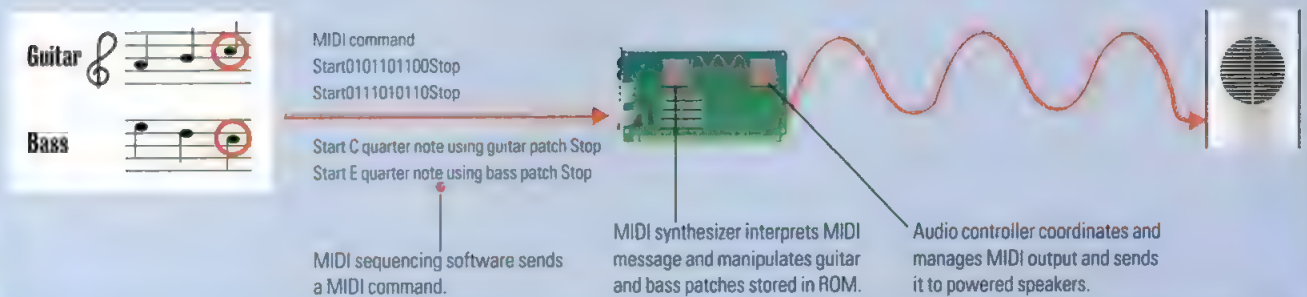
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How .WAV AND MIDI WORK

You create .WAV files much the same way you record using a regular tape recorder.



A MIDI file is simply a set of commands telling an on-board MIDI synthesizer to manipulate and play instrument sounds that have been programmed or prerecorded and stored in ROM.



tower is the perfect choice. While a CD jukebox can accommodate more disks, a tower provides simultaneous access to all loaded disks and allows several users to access the same disk at once.

Our perfect CD-ROM tower houses several SCSI-2 drives (from six to nine, depending on the vendor) in a tower case. The drives have attached controllers and can be swapped in and out on the fly; SCSI IDs are controlled by the bay position of the drive. Some systems even let you hook several towers together or add other SCSI devices, such as a tape drive, to the tower. The earliest towers were dumb devices that needed to be hooked to file servers. But vendors are coming to market with quad-speed CD-ROM server towers (such as the Plextor PleXServer), complete with CPUs and network interface cards so they can be hooked directly to the network. This can save you money, as opposed to buying a separate server, and it allows access to the CD-based data and applications even if the file server goes down.

ADDING SOUND TO VISION

When it comes to sound boards, you can spend \$79 and get a card good enough for modest needs, or \$400 and still not get all the features you want. At the very least, you'll want a card that delivers CD-quality digital audio. This means the card must offer 16-bit, 44.1-kHz stereo sampling (every second, the card takes 44,100 16-bit samples) for recording and playback. Because files created at this sampling rate require a lot of storage space, a sound card needs to support the most popular compression standards. *ADPCM* (Adaptive Differential Pulse Code Modulation) compresses files by as much as 4:1, while the emerging *MPEG* (Motion Picture Experts Group) compression, gaining popularity for both video and audio, can compress up to 12:1. TrueSpeech is another leading standard used for speech recording and playback, and can compress up to 10:1.

Also important is the quality of a board's analog components (such as the preamp) and circuitry. Some components

introduce significant noise and hiss, as we found in our recent review (see "An Earful of Sound Boards," March 28, 1995, for a list of boards that proved satisfactory). The perfect sound board also supports the General MIDI standard for playing MIDI sounds. *MIDI* (musical instrument digital interface) is simply a set of commands and communication standards for the transmission of data among electronic musical instruments and computers. A MIDI command issued by an instrument (such as an electronic keyboard) or an application (such as a game) tells the synthesizer on the board which instrument to play, at what note, and for what duration. Compliance with General MIDI assures you'll get the intended instrument sound when a MIDI command is issued. Since MIDI messages are just 8-bit commands, they take up much less storage space than digitized sound files and are prevalent in games and edutainment titles.

Most users will also want a sound board equipped with a *wavetable* synthe-

**No other
sound card
ever made
this kind
of uproar.**

"Creative Labs just keeps on improving on the design that made it famous. This latest revision of the Sound Blaster features a host of innovations. For example, it has both a 20-voice FM synthesizer and a 32-voice digital sample playback synthesizer for more realistic MIDI sounds. The QSound feature delivers surround-sound effects to your WAV files or you can choose to enhance them with such effects as stuttering and echo. Lots of useful applications come in the box, too, including the easy-to-use VoiceAssist speech-recognition software and well-rounded TextAssist for text-to-speech tasks."

HOME OFFICE COMPUTING / JANUARY 1996

"I heartily recommend the Sound Blaster AWE32. The 100% sound-effects compatibility and impressive music capabilities, make AWE32 an excellent all-round performer."

"To me, using a computer without sound and music is like driving a Lamborghini without the roar of its V12 engine. The

CD-ROM Multi Media Magazine November / December 1994

AWE32 is completely compatible with the whole range of Sound Blasters. The MIDI side of the AWE32 has been enhanced to provide it with the kind of sound you would expect from a professional synthesizer."

"...if sound quality and performance is important, you can't go wrong."

QSound to widen and enhance the stereo effects of sounds."

Sound Blaster AWE32 has Creative Labs' suite of sound playback and editing software that does the job with admirable simplicity—and the addition of sequencer Cakewalk Apprentice and the presentation program HSC Interactive SE rounds out the bundle nicely. And of course, the Sound Blaster AWE32 is compatible with software written for older Sound Blasters, so it will work on anything from Windows to Doom."

PC Computing December '94

BEST BUYS



"For flexibility necessary for business-related audio, turn to the Creative Labs Sound Blaster AWE32, which stands out with decent sound quality and excellent software that includes 3D sound and text-to-speech and speech recognition capabilities. Its lavish documentation is another welcome feature. The AWE32 gave us the smoothest rides and the best sound in the games we tested."

174 PC WORLD • DECEMBER 1994

SOUND CARDS

"Creative Labs has long been the leader in this market, with its Sound Blaster series setting the standard for PC sound. The \$399 AWE32 is the most advanced card in the Creative Labs lineup. It has everything you'd want in a general-purpose audio board."

Electronic World/January '94



It seems the Sound Blaster™ AWE32 has the critics buzzing. For the first time, it puts awesome professional studio sound within the reach of the hungry audiophile. And of course it's genuine

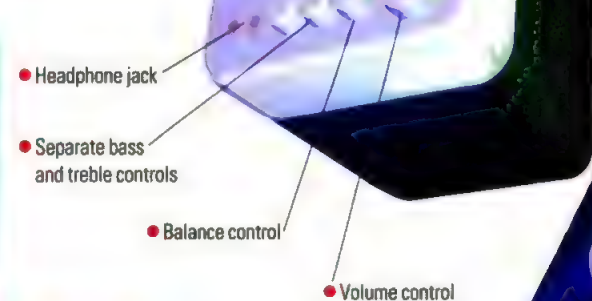
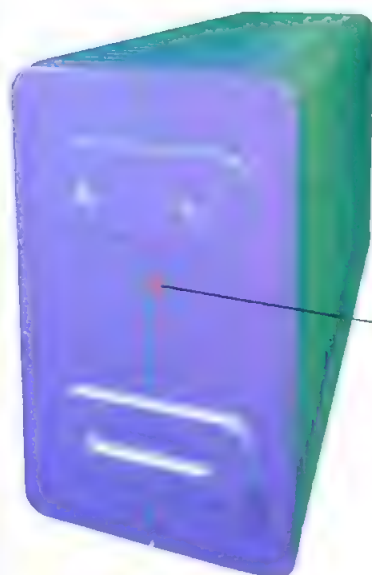


Sound Blaster compatible. So now that you've heard the experts' opinion, how about coming up with one of your own? Simply visit your local Creative Labs dealer. Or call 1-800-998-5227 Ext. 121.



The PERFECT SPEAKERS

Speakers can make or break your multimedia system. The perfect speakers have powerful amplifiers and deliver clean stereo sound, from crystal highs to rich bass. **Price: \$250.**



• Headphone jack

• Separate bass and treble controls

• Balance control

• Volume control

Separate subwoofer

For fuller bass response, you'll want a three-piece speaker system that features a stand-alone subwoofer. This piece can be placed on the floor out of the way.

Built-in power amplifier

Since most sound cards have weak amplified output, the perfect speakers have their own quality amplifiers that don't distort the audio signal. For individual use, 10 to 20 watts of power should be sufficient. You'll need up to 30 watts if you have to fill a small conference room with sound.

Speaker placement

Unlike home-stereo speakers, most PC speakers are designed to deliver noticeable stereo separation when placed fairly close together. Look for units that offer mounting brackets, so you can hang them on your monitor.

Woofer

This speaker component delivers the low- and mid-frequency sounds, which make up the bulk of music and voice recordings.

Magnetic shielding

This is necessary to prevent your speakers' magnetic fields from interfering with your monitor.

Line-in jacks

These connectors (either ministereo or RCA) let you hook more than one audio source to the speakers.

sizer to respond to the incoming MIDI commands. Less expensive boards often rely on *FM synthesis*, where programmed sine waves are used to produce instrument sounds—usually unconvincingly. A wavetable synthesiser, on the other hand, manipulates digitized samples of actual instrument sounds, resulting in fuller, more realistic audio. These samples are stored in ROM chips on the board; better cards offer 8MB of samples, typically compressed into 4MB of on-board ROM. A better board will also contain at least

1MB of on-board RAM to store samples downloaded from your hard disk.

Another feature you may want is a digital signal processor, or *DSP*. DSPs can perform any number of specialized tasks, from adding special sound effects to incorporating fax-modem capabilities. A DSP can relieve your CPU of an otherwise burdensome task or add functionality not found on a traditional sound card. Many DSPs are software-programmable, so functions can be upgraded down the line.

Beyond these basics, you'll need to con-

sider features tailored to specific needs. Multimedia authors, for instance, need to insist on top-quality components to ensure the integrity of recordings. You'll also need a robust mixer to mix signals from several devices such as audio CD players and microphones. If playing computer games figures prominently into your idea of the perfect multimedia experience, you need a card that offers 100 percent Sound Blaster compatibility. Based on the specification from Creative Labs, this standard is widely used in DOS games. Note that

If you want to
send a message to
a customer on a
different operating
system, you have
two options.

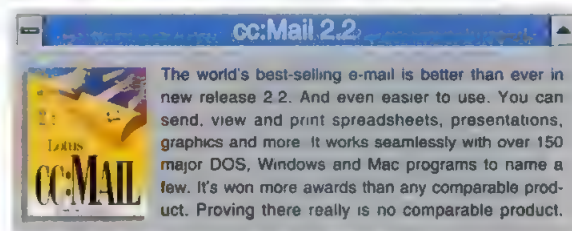
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With all due respect to the post office, there are more efficient ways of communicating in business. E-mail is a perfect example. Thing is, there's only one e-mail package available that allows you to simply communicate with anyone you want—colleagues, customers, vendors—no matter what operating system (Windows™, DOS, OS/2®, Macintosh® or UNIX®), host system or e-mail product they use: cc:Mail™ from Lotus®.

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THE PERFECT PC
Multimedia Add-Ons

some vendors do not license the spec from Creative Labs and claim "100 percent game compatibility"; that means the sound will work, but not all sounds may be the ones the game developers intended.

You'll want a full complement of audio connectors to connect other peripherals: line-out for powered speakers, variable line-out for nonpower speakers, a microphone jack, line-in to attach audio components, and a MIDI/joystick port to attach an electronic instrument or game controller. Make sure the card comes with a Red Book connector if you intend to listen to audio CDs on an internal drive.

Business users more interested in the bottom line than top-quality music synthesis could slip by with a less costly FM-synthesis board that offers a wavetable upgrade option. Voice mail and similar uses are usually more forgiving when it comes to audio fidelity, and users who decide they need wavetable synthesis can plug in the appropriate daughter-card down the road. Instead, look at what software comes bundled with a card. The basic voice-recognition and



*Business users could
slip by with an
FM-synthesis board.*

text-to-speech utilities may prove handy, as will a microphone.

THE PC-BASED TELEPHONE

Many business users may want to consider one of the do-everything cards newly on the market. A typical card includes a 14.4-Kbps fax modem and voice-processing capabilities in addition to traditional sound card components. The extra functions are

handled either by dedicated chip sets or through a DSP. If upgradability is important, a DSP-based card can often be reprogrammed to incorporate a faster modem or new sound-compression schemes. But separate chip sets can usually handle concurrent tasks without slowing down.

Finally, all users will have to grapple with installing the sound card they choose. Sound cards have been perhaps the most notoriously recalcitrant items to add to a PC. But many sound boards now ship with configuration utilities that help you identify and troubleshoot resource conflicts, and vendors are moving away from hardware DIP switches and jumpers to completely software-configurable designs.

PLUG AND PLAY

More installation help appears to be on the horizon, and not just for sound cards. The Intel/Microsoft Plug and Play (PnP) specification for peripheral devices promises to alleviate, at least partially, PC configuration problems. Intel has developed a utility named ICU that lets DOS and Microsoft Windows 3.1 users take ad-

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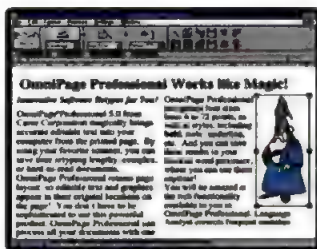
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CIRCLE 292 ON READER SERVICE CARD

THE PERFECT PC
Multimedia Add-Ons

vantage of the flood of PnP devices expected to hit the market soon, and IBM has pledged support for OS/2 users. But those who migrate to Windows 95 will likely realize the greatest benefits.

At its best, the new operating system will be able to detect automatically the presence of new PnP devices and configure them for you, carefully avoiding resource conflicts with already-installed devices. But this best-case scenario assumes you have a PnP system BIOS and all PnP devices, in addition to Windows 95. Still, in our hands-on testing of a late beta of Windows 95 (see "Effortless Upgrades," May 16, 1995), we found that the extra intelligence built into the OS offered at least some help in older PCs with legacy hardware.

The advent of Windows 95 promises other changes to the world of multimedia, as well. CD-Plus, a new CD format being touted by Philips, Sony, and others, will offer mixed-mode CDs: disks that contain both traditional audio tracks plus PC data. Pop such a disk into your CD-Plus-compliant audio player and you hear the album. Pop it into your CD-ROM

drive, though, and you get the audio plus any manner of multimedia entertainment or information it contains. The Windows 95 file system will be able to decipher the CD-Plus file format, while Windows 3.1's MSCDEX cannot.

Microsoft is also distributing a new game SDK (software development kit) that promises to deliver better video performance for games and other titles under Windows 95. The new APIs (application programming interfaces) will give developers more direct access to hardware. This will enable the games to bypass the operating system's GDI layer (a video bottleneck).

SPEAKERS

Unfortunately for most PC users, the final and pivotal piece of the multimedia puzzle is often an afterthought. You can get a good pair of speakers for around \$100. For \$200 to \$250, you get the perfect speakers: a three-piece speaker system that delivers two stereo speakers, each containing its own woofer (to handle low and middle sound frequencies)

and tweeter (for the highest frequencies), plus a subwoofer to add richness to the bass.

You'll need to make sure the speakers are self-powered; that is, that they have a built-in amplifier. We have found that the amplifiers, even on good-quality sound boards, deliver an anemic 2 to 4 watts of power and add an unacceptable amount of distortion. For individual use, the perfect speakers offer 10 to 20 watts of power per channel, though we've found acceptable units in the 5- to 10-watt range, as well. If your speakers need to fill a small conference room with undistorted sound, get 20- to 30-watt units.

You'll also want some extra touches, including a headphone jack; volume, balance, and bass and treble controls; and mounting brackets to hang them from your monitor.

Above all, with speakers as with other devices, nothing can take the place of seeing and hearing a multimedia system in action. Evaluate the ergonomics of the drive and the audio quality of the sound board and speakers in person to find what's perfect for you.□



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Building the Perfect Network

Here's what you need to start planning for the LAN of today, which has the right blend of performance and features for the workload of tomorrow.

By Frank Derfler, Jr.

The PERFECT NETWORK

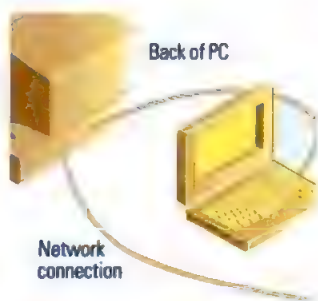
The perfect network is a collection of standards-based devices that link all of a company's desktops, hosts, and resources without sacrificing on speed, cost, or manageability.

Perfect router

Connecting your network to other networks, particularly remote networks, is where routers shine. The best departmental router can pass lots of network protocols, and can connect two LANs and two WANs. It costs about \$2,000.

Wide-area connections

You have three choices when connecting to remote LANs: switched circuits (ISDN or Switched 56), packet-based networks (X.25 or frame-relay), or dedicated lines.



Perfect laptop connection

A laptop can be tied to the network through PCMCIA or parallel-port adapters or connected to a networked PC. For the necessary software, consider the built-in laptop-to-PC functionality of Microsoft Windows 95.

Perfect administration application

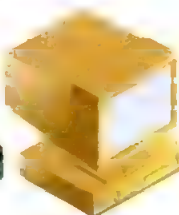
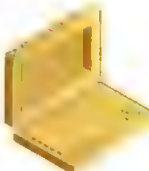
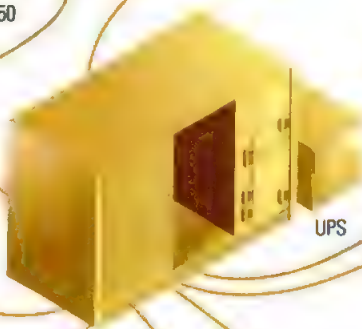
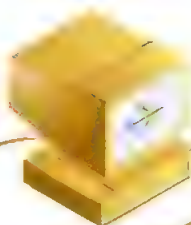
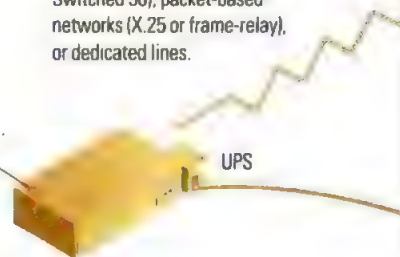
With the right network-administration package, such as Intel's LANDesk, you can track the hardware and software on your LAN, monitor software usage, and be notified when problems occur, all for about \$50 a user.

Perfect network adapter

Adapters connect PCs to LANs. The perfect client adapter is cost-effective (\$99) and uses PCI. A server adapter should be optimized for speed, use less than 20 percent of CPU resources, and be PCI-compliant. It should also connect to a 100-Mbps network for future growth.

Perfect hub

Hubs connect cables from network adapters and other devices into a single network. Look for top-notch management and an assortment of connectivity options for about \$75 per port.



You might change your PC hardware almost as often as you change your socks, but networking is made of sterner stuff. As with the plumbing in your walls, you'll renovate all around the network, but you'll hesitate before tearing into it. The perfect network is a long-term investment, and it's best to do it right the first time.

Like any system, the perfect network

is a blend of elements. The criteria for choosing each of these are capacity and flexibility; cost is a distant third. The relative importance of each factor depends on your particular network. Generally, enterprise networks emphasize connectivity, manageability, and performance, while small offices tend to scrutinize the bottom line. Corporate workgroups mix all of these factors. Let's get down on our

bellies and crawl under the counters to look more closely at the pieces of the perfect LAN.

PERFECT CABLING

Today, *unshielded twisted-pair* wiring (UTP) is the clear choice for all network connections on the same floor of a normal-size building. UTP meeting a specification called *Category 5* can carry data at 155

Perfect switch

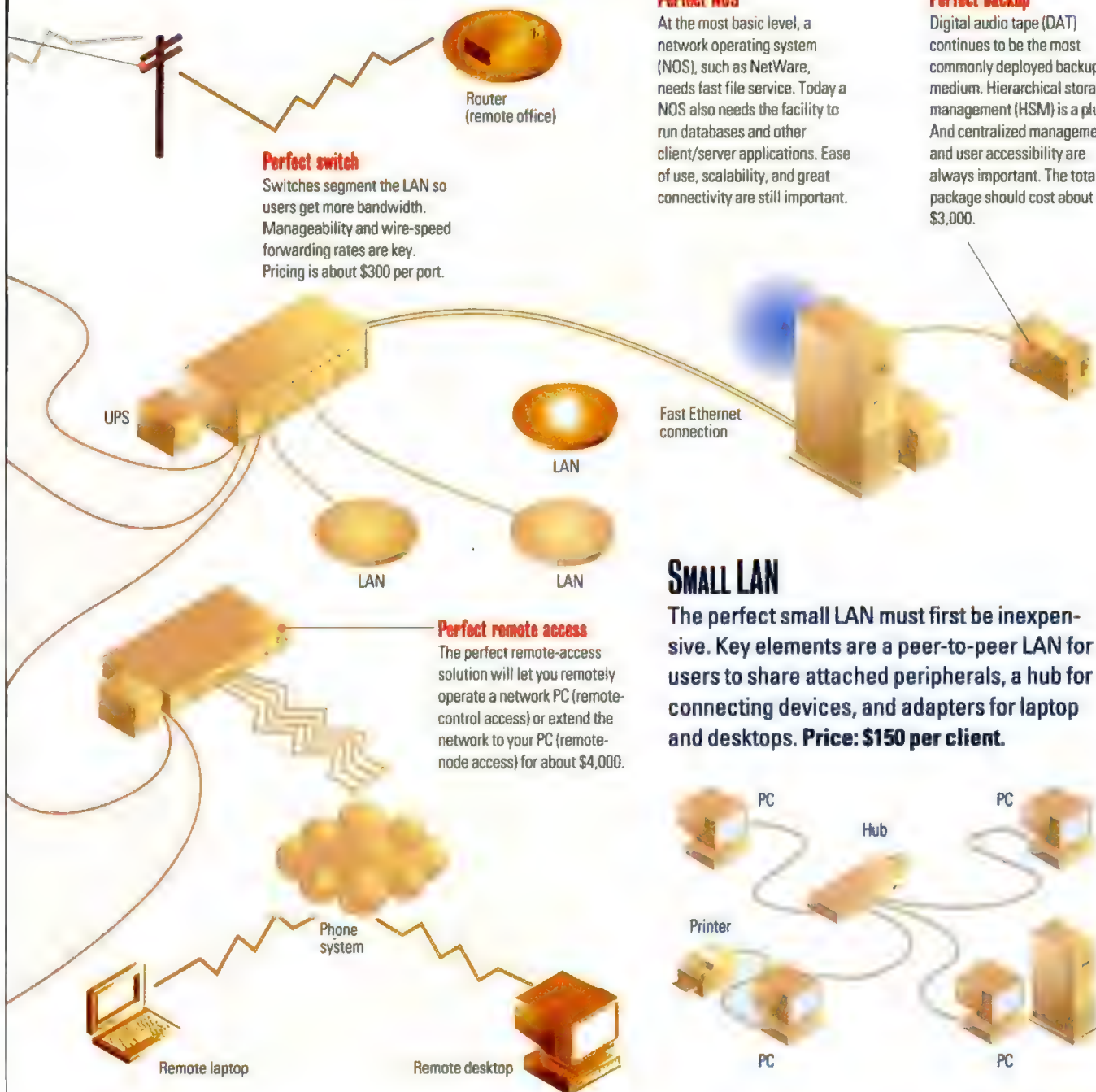
Switches segment the LAN so users get more bandwidth. Manageability and wire-speed forwarding rates are key. Pricing is about \$300 per port.

Perfect NOS

At the most basic level, a network operating system (NOS), such as NetWare, needs fast file service. Today a NOS also needs the facility to run databases and other client/server applications. Ease of use, scalability, and great connectivity are still important.

Perfect backup

Digital audio tape (DAT) continues to be the most commonly deployed backup medium. Hierarchical storage management (HSM) is a plus. And centralized management and user accessibility are always important. The total package should cost about \$3,000.



SMALL LAN

The perfect small LAN must first be inexpensive. Key elements are a peer-to-peer LAN for users to share attached peripherals, a hub for connecting devices, and adapters for laptop and desktops. **Price: \$150 per client.**

RELIABLE?

What can we say? There are a lot of cables. There are a lot of power supplies. There are a lot of potential points of failure. A typical serial port adapter with four external modems has a MTBF of 9,833 hours. A typical serial port adapter with eight external modems has a MTBF of 5,408 hours. That's about a 1/4 of the MTBF of Xircom's Netaccess MultiPort Modem Card.

MANAGEABLE?

Flicker, flicker, flash flash. What do they say? What do they mean? Trying to manage remote access communications by watching modem lights flicker on and off is more frustrating than informative. And at best, you only know what's happening on one side of the fence.

SCALABLE?

Add another card, add another modem, rearrange the spaghetti, push the whole mess back into the closet, hope nothing comes loose or gets unplugged.

PERFORMANCE?

Once you've sorted out this mess, you can sit back and start listening to the complaints about performance bottlenecks, serial port speeds, and woefully slow UARTs that process byte-by-byte, character-by-character, interrupting your server to fetch minuscule chunks of data.

REMOTE ACCESS OUT OF CONTROL.

Now it's really easy for you to extend your network operating system along with all of your applications, from e-mail to database services, to all of your remote users without stocking and maintaining a closet full of modems, cables and power supplies.

Introducing the new Netaccess MultiPort Modem Card from Xircom, the open systems approach to remote access. It's the first multi-

modem interface card to support both your remote access and your application servers.

Available in configurations of either four or eight V.34, 28.8Kbps modems and their RJ-11 connectors integrated into single PC adapter cards, the Netaccess MultiPort Modem Card does for remote communications what NICs do for local communications.

Insert a Netaccess MultiPort Modem

Card in your server and load the drivers for your Novell NetWare Connect or Microsoft Remote Access Service. If you're working in a different OS environment, just configure the Xircom Netaccess card for comports. It's really that simple. Your remote users now have full access to all the applications and services they use on their LAN locally.

And you have more than four times the



RELIABLE

With the RJ-11 connectors attached directly to the Netaccess MultiPort Modem Card, the vast majority of cables and power supplies of external modems are eliminated. MTBF for a Netaccess MultiPort Modem Card with four V.34 modems is 41,791 hours. Calculated MTBF for a Netaccess MultiPort Modem Card with eight modems onboard is 23,076 hours.

PERFORMANCE:

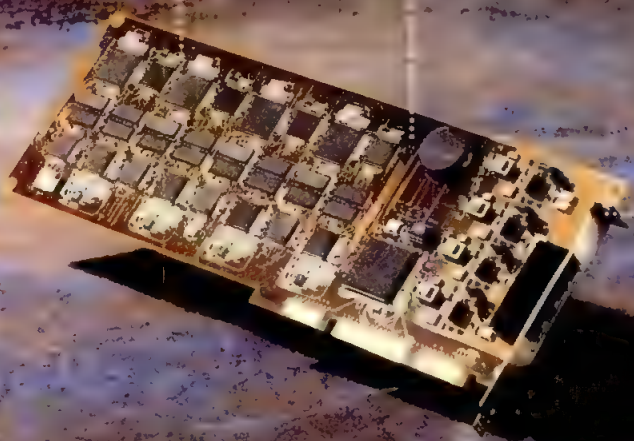
No waiting for UARTs, no serial port bottlenecks, just big blocks of data moving swiftly and smoothly between your Netaccess MultiPort Modem Card and your server.

MANAGEABLE:

The Xircom Netaccess MultiPort Modem Card lets you monitor the status of your local modem connections, including speed, type of compression in use, type of error detection in use and more on your SNMP workstation.

SCALABLE

Add another four or eight ports by adding another Netaccess MultiPort Modem Card to a maximum of 64 ports per server depending upon host system resources. No mess, no fuss, very little spaghetti.



REMOTE ACCESS UNDER CONTROL.

reliability of other remote access solutions and none of the nasty maintenance hassles that come along with serial port boards.

As your needs grow, you can simply add multiple boards to accommodate up to 64 ports for every server you want to mount.

Xircom Netaccess MultiPort Modem Cards are the easy-to-install and very easy-to-monitor remote access solution that is

scalable, reliable and totally compatible with the network operating system you're running today. So don't let remote access get out of control in a closet full of modems, cords and twisted spaghetti.

Get it under control with a Netaccess MultiPort Modem Card from Xircom.

Call for more information and our latest Netaccess MultiPort Modem Card pricing.

CALL NOW FOR PRICING DETAILS:

1-800-438-4526 ext. 47B
FactsLine: 1-800-775-0400

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The Mobile Networking Experts.



NETWORK ADAPTER

An adapter should be easy to install and require no configuration; a PC should be able to discover and configure it automatically. And no perfect client adapter would *dare* have a jumper. **Price: \$99.**

Boot PROM

For workstations without disk drives, an adapter's boot PROM contains the software to connect to the network.

Flash RAM

The adapter's flash RAM provides upgradable configuration information and even a virus checker and desktop-inventory information.

On-board CPU

An on-board CPU for bus-mastering relieves the PC's CPU from all the processing; this is especially important in file or application servers.

Bus connector (PCI)

A PCI bus connector provides the best performance and easiest installation of any bus type.

Perfect server adapter

The perfect server adapter must be EISA or PCI, and it must be fast. Its CPU utilization must be low enough (under 20 percent) so that other server tasks aren't hindered.

Chip sets

Application-specific integrated circuits (ASICs) can provide complete functionality on a single chip, keeping cost down and performance high.

LED key

Link (LNK)
Power (PWR)
Transmit (TX)
Receive (RX)
For Ethernet:
Collision (COLL)
For Token Ring:
Beacon (BCN)

Ethernet

An Ethernet adapter should have three connector options: RJ-45 (UTP), AUI (10Base5), and BNC (10Base2, thin and thick coax).

Token-Ring

A Token-Ring adapter should have two connector options: RJ-45 (UTP) and 9-pin D Connector (IBM Type 1 STP).

FDDI

Both single- and dual-attached adapters should be available, as well as Category 5 UTP connectors for CDDI.

Mbps and faster and should serve your needs for a decade. Typically, fiber-optic cable connects closets full of equipment on different floors and across a campus.

Our perfect network starts out with Category 5 cabling specifications and is designed for capacity and flexibility. Whether you are connecting 5 computers in the same room or 5,000 computers across ten buildings, the Category 5/fiber-cable formula remains the same.

NETWORK ADAPTERS

A LAN adapter converts the high-powered serial stream of data from the network cable into the well-mannered parallel data flow needed inside the PC.

If you have a network, the decision between the Ethernet and Token-Ring network signaling and media access control (MAC) schemes has already been made. If you're starting fresh, we'll just say that Ethernet is far more popular than Token-Ring for reasons of economy and flexibility.

Two new signaling schemes, *100Base-T* and *100VG-AnyLAN*, offer alternatives for anyone starting new or upgrading an existing installation.

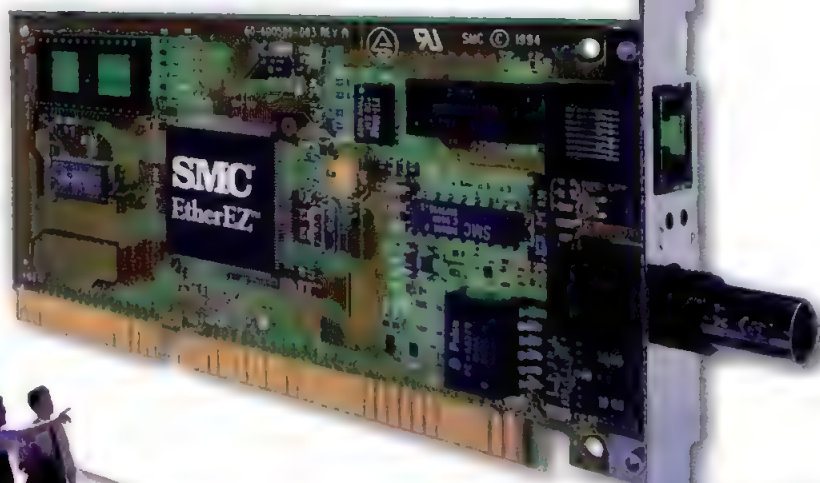
A technique called *bus mastering* allows the adapter to move data to and from memory without disturbing the PC's CPU, thereby reducing *CPU utilization*. PCI adapters can access this memory path quickly, so they move data efficiently and

keep CPU utilization low. PCI adapters also feature much easier installation than the old ISA or EISA bus architectures. Some new adapters have firmware for Microsoft's Plug and Play or the *Desktop Management Interface* (DMI), an interoperability standard sponsored by a large consortium of vendors.

Our perfect network uses PCI 10/100 adapters for 100Base-T. This combination gives us products from many vendors, great capacity to move a lot of data, good flexibility, and good economy.

HUBS

The hub connects a group of network nodes while isolating each node from



Any way you look at it, it's the best Ethernet card for you.

With 24 years' experience and 10 million network cards sold, SMC knows what you need in an Ethernet card. Fast and easy installation. Exceptional performance. Great price. And 100% satisfaction, guaranteed.

You'll find that and more in SMC's EtherEZ.

For starters, no Ethernet card is easier to install. You can network a PC with EtherEZ in less than a minute.

EtherEZ is also the fastest ISA Ethernet card we've ever made—and it rivals the performance of any other card on the market.

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hundreds of operating systems. EtherEZ drivers ship with Novell, Windows NT, LANtastic, Banyan, and even Windows 95.

Best of all, we've reduced our price, so EtherEZ's price/performance challenges any competitor's.

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We're so sure EtherEZ is the best Ethernet card for you, we've backed it with an unprecedented guarantee. Try it. You'll be 100% satisfied, or we'll replace it with the card of your choice*, free.

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Token Ring Adapters

Portable Connectivity

Ethernet Hubs

Token Ring MAUs

Bandwidth Acceleration

Ethernet Switching

Token Ring Switching

Stackable Hubs

Intranetworking

Backbone Solutions

Fast Ethernet Solutions

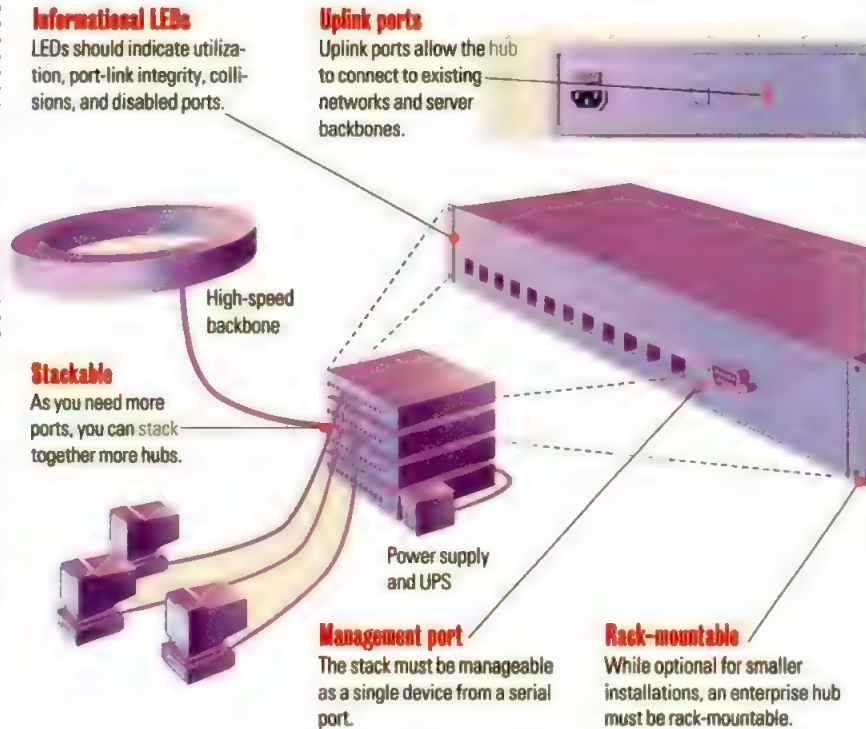
Multiprotocol Switching

ATM, HSSI, FDDI

The PERFECT HUB

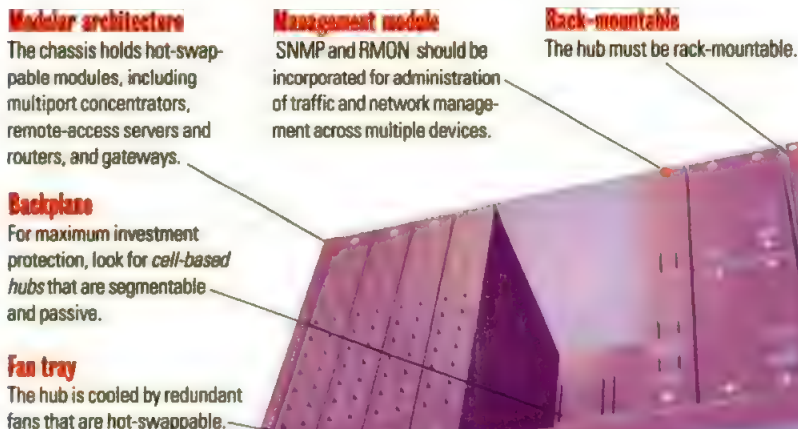
DEPARTMENTAL HUB

The perfect departmental hub is stackable, expandable, easy to install, and, of course, inexpensive. **Price: \$75 per port (about 16 ports).**



ENTERPRISE HUB

The perfect enterprise hub comes as a rack-mountable chassis with expansion slots for different types of modules. **Price: \$175 per port.**



trouble on other cable segments. Hundreds of hubs are offered by companies such as Bay Networks, Cabletron, Digital, IBM, and 3Com, as well as by less-known vendors such as Asante and Optical Data Systems.

Using the criterion of capacity, you want a hub with enough ports for all of the nodes in the area. A *departmental* hub generally has 8 to 12 ports in a fixed configuration. Each departmental hub links to other hubs across the network, so you can add capacity hub by hub. A subcategory called *stackable* hubs lets you treat several hubs—and often routers, protocol analyzers, or remote access servers—as a single unit. The stackable hub avoids certain technical limitations in linking hubs together across the LAN yet lets you add greater functionality as you need it. With stacking, it's often easier to manage the different devices in the stack together than as separate devices on the network.

A more flexible *enterprise* hub allows you to slide modules into a chassis equipped with features such as redundant power supplies and sophisticated management. A *backplane* (like the expansion slots in a PC) allows you to interconnect the various enterprise hub modules.

But flexibility and reliability cost more. A relatively simple *departmental* hub might cost about \$30 per port. With an added processor for Simple Network Management Protocol (SNMP) management, a hub would be about \$75 per port for 16 ports. An enterprise hub equipped for remote SNMP management could cost \$175 or more per port in a 300-port configuration.

In a perfect network you would use only chassis hubs for the ultimate capacity and flexibility. In a world of real budgets, however, a combination of stackable hubs and chassis hubs is a practical and flexible solution. In either case, our perfect hub should include a set of LEDs to tell us the condition of each port on the network and the amount of traffic on the network.

SWITCHES

The wiring closet is the site of a performance option called a switch. In a standard network, each node follows a *media access control* (MAC) scheme, such as Ethernet or Token-Ring, to share the

YOU CAN SPEND MUCH MORE ON REMOTE CONTROL SOFTWARE.

Introducing NetRemote. The most affordable complete remote control software.

It's amazing, really. Other remote control programs are almost three times as expensive as the new NetRemote from McAfee. But they provide fewer features.

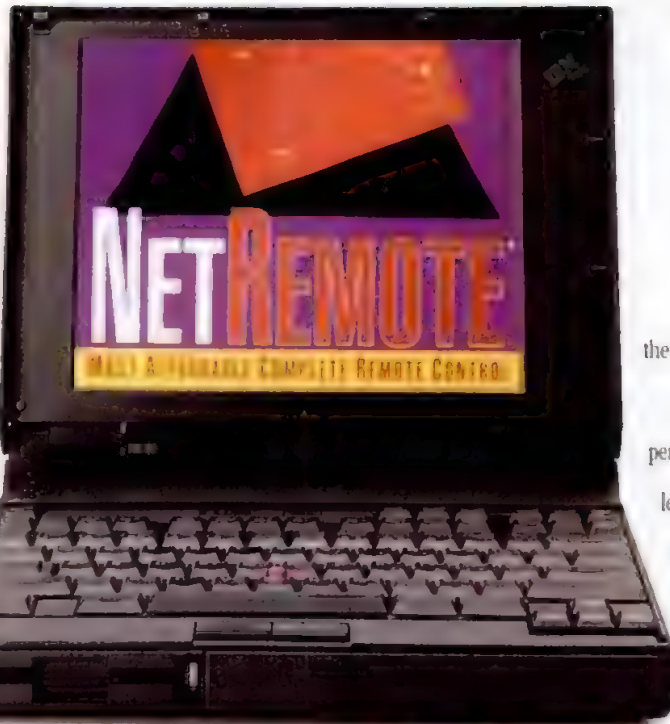
It's even odder when you consider that NetRemote is the easiest to use. NetRemote installs itself, configures your modem automatically and executes functions at the push of an on-screen button.

Only NetRemote does it all.

Unlike the competition, only NetRemote lets you share data and run programs back and forth between your office PC and remote laptop computer. No matter which one holds the programs or files being accessed.



With NetRemote, all functions are accessible from a simple pushbutton control center.



BUT ONLY IF YOU WANT MUCH LESS.

	NetRemote	pcAnywhere	Carbon Copy
Extended modems	\$49.95	\$120	\$130
E-drive and drive mapping	Yes	No	No
16 million color support	Yes	No	No
Local mail	Yes	Yes	No
Local modem configure	Yes	Yes	No
Remote printing	Yes	Yes	No

And only NetRemote provides support for 16 million colors and automatically synchronizes your office and laptop PCs to provide

the highest possible screen resolution.

Of course, NetRemote brilliantly performs those functions it shares with lesser programs. To transfer files, just drag and drop. For e-mail, just push a button. Even remote printing is only a trackball click away.

All this and the most affordable price, too.

There's simply no easier, more powerful or more affordable way to access your office

PC from the road. Your LAN administrator will also like NetRemote because it can reduce the support cost of remote access.

And yet, it's powerful enough to provide

that access to the entire network, across the hall or across the country.

To order, or for the name of your nearest NetRemote retailer, just call **800-332-9966**. Or, simply "Download McAfee" from the Internet today. And see how much you can get by spending less.



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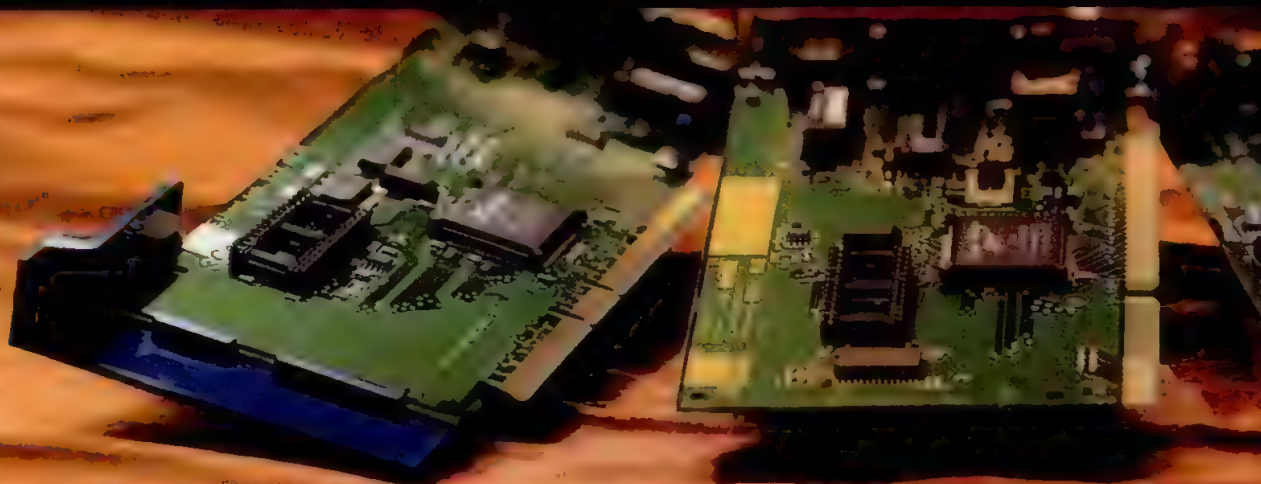
CIRCLE 299 ON READER SERVICE CARD





EtherLink III Parallel Tasking PCI

Introducing the hottest adapter to



EtherLink III MCA

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You might say we're on a roll. Presenting 3Com's EtherLink® III PCI adapter, the newest addition to our long line of powerful adapters for the industry's hottest new bus type. And the best performing Ethernet PCI adapter available. All at a price that makes it an extraordinary value.

The EtherLink III PCI Adapter Card.

Like the rest of the EtherLink III adapter family, EtherLink III PCI comes with 3Com's patented Parallel Tasking® technology. So you're assured the fastest possible network performance. Always.

Plus, its bus master design offloads the system's



come along since, well, our last five.



EtherLink III PCMCIA

EtherLink III EISA

Fast EtherLink PCI 10/100

CPU so both clients and servers perform at optimal levels. And the EtherLink III PCI adapter card is guaranteed to be compatible with all PCI-compliant machines, or your money back.

Add full SNMP manageability and easy, virtually instant installation, and it's clear our newest member is

fully living up to the family name. For more information, and to get a \$59* EtherLink III PCI evaluation card, call 1-800-NET-3COM.

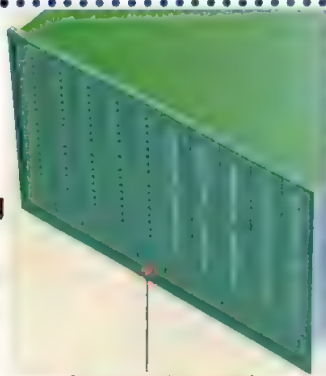


The PERFECT SWITCH

When Ethernet clogs up, consider replacing the hub with a departmental switch.

A departmental switch segments a big LAN into smaller LANs, effectively giving more bandwidth (up to 10 Mbps) to each client.

Price: \$300 per port.



Internetworking switch

The internetworking switch connects switches together. The perfect internetworking switch would support large numbers of MAC addresses and have options for fiber.

High Ethernet-port density

Expect the switch to start with 4 to 16 ports, but this can be increased as needed.

CPU and RAM

The switch needs a powerful CPU and sufficient RAM to provide a wire-speed non-blocking architecture.

Low per-port cost

Expect to pay \$300 for managed switches. Each port should support multiple MAC addresses for connecting multiple PCs to a single port.

Management subsystem

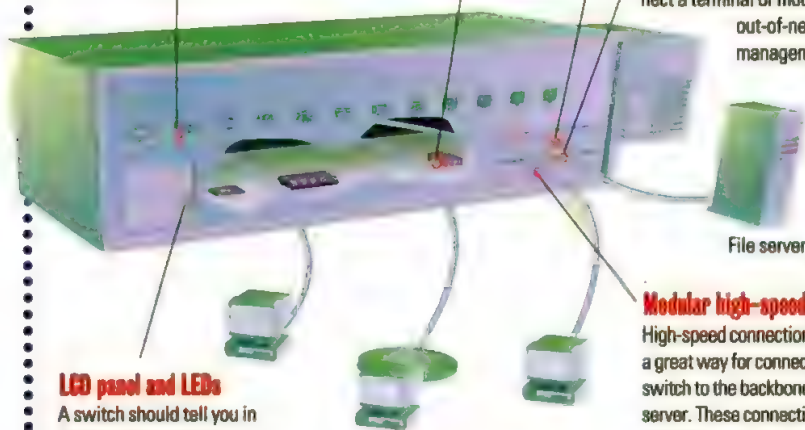
Look for products that offer the Simple Network Management Protocol (SNMP) and the extended Remote Monitoring (RMON) specification.

Routing and bridging

Translational bridging is the fastest route to switch from Ethernet to a high-speed network, but routing provides better control over traffic.

Management port

Look for a serial port to connect a terminal or modem for out-of-network management.



File server

LCD panel and LEDs

A switch should tell you in English its status via an LCD panel—"High number of errors from port 3," for instance. Well-labeled LEDs are also valuable for information at a glance.

Multiple-frame support

There should be no limitations on what types of frames are switched: On the Ethernet side, 802.2, 802.3, and Ethernet SNAP must pass through seamlessly.

Modular high-speed ports

High-speed connections are a great way for connecting a switch to the backbone or a server. These connections should come as hot-swappable modules, and you should be able to choose among FDDI, Fast Ethernet, or ATM. High-speed ports should be switched so that only appropriate packets are forwarded.

Cut-through

Cut-through switching is faster, but at the expense of error checking. The switch reads in only the destination address before forwarding the packet.

Store and forward

The switch reads in the entire packet before forwarding it. This makes the switch slower but ensures that forwarded packets are error-free.



time on the cable. The more nodes on a LAN, the less time each node has for transmission. A switch isolates and buffers data so that each node enjoys unlimited access to the cable and improved throughput.

A switch is the easiest, most economical way to improve the performance of a busy network. The base price is generally about \$300 per node, and that cost rises quickly as you add options such as fiber-optic cable connections and network management. Switch vendors include the likes of Digital Equipment Corp., Kalpana, Networth, and 3Com. (Our latest roundup of switches was "Switching to the Fast Track," October 11, 1994.)

Many switches have at least one specialized fast connection for a file server. One subcategory of switches, called the *internetworking* switch, is designed to link a network of switches. It has more ports, more processing power, and connections for wide area network links.

ROUTERS

Communication servers come in many shapes and in many functional roles, but primarily they extend the 10- or 100-Mbps high-speed local area network beyond its mile or so of practical coverage and out into a *wide area network* (WAN). Communication servers that link LANs typically use sophisticated packet-inspection techniques to route their traffic to its destination, so they are called *routers*.

Routers can operate over a variety of different telephone lines. *Leased lines* are digital phone lines; the so-called *T-1 circuit*, operating at 1.544 Mbps, is a popular form of leased line. But because a full-time transcontinental T-1 can cost \$10,000 per month, a part-time dial-up service called the *Integrated Services Digital Network* (ISDN), with two 64-Kbps channels for data, is growing in popularity.

Routers, such as those from Cisco Systems, are like highly automated shipping platforms. They read the data packet, strip it from its Ethernet or Token-Ring digital envelope, wrap it in another package for shipment across a link, and control its travel. The perfect router has the programming to read many different networking protocols, including IPX/SPX, TCP/IP, and AppleTalk.

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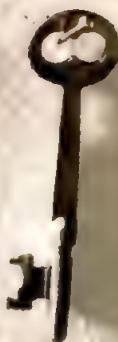
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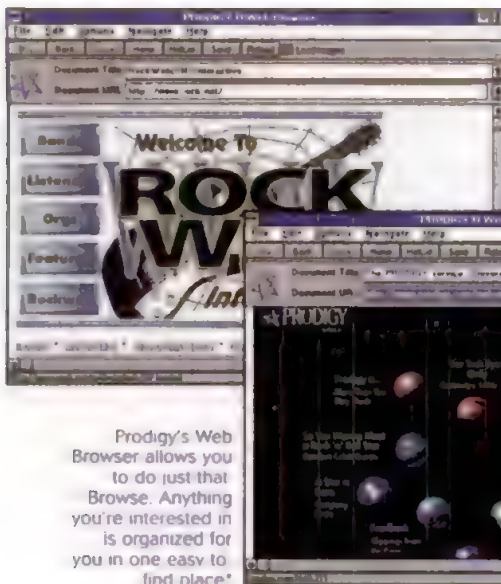
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The PERFECT ROUTER

Lose the router and your internetwork comes to a halt. The perfect departmental router connects far-flung offices to corporate headquarters without sacrificing expandability or management. **Price: \$2,000.**

Enterprise router

The enterprise router keeps your entire network connected. This router must have about ten expansion slots for modules with about four network connections. Strong network and routing protocol support is a must.

Easy installation and configuration

A configuration file should be available. If there is no central-site router, the configuration interface should be intuitive and automated.

Protocol prioritization

Protocols like NetBEUI and SNA are sensitive to delays. Protocol prioritization helps ensure that sessions using these protocols won't time-out when crossing the WAN.

Routing protocols

Routers use these to talk among themselves. Insist on RIP for handling IP and IPX traffic, and RTMP for AppleTalk. Ideally, you'll also want the faster OSPF for handling IP traffic and Novell's NLSP for IPX. Cisco sites will want Cisco's IGRP.

Network protocols

The more protocols the router supports, the better. At a minimum, look for IPX, TCP/IP, AppleTalk, and bridging of all other protocols.

Central management

The router must be manageable via the Simple Network Management Protocol (SNMP) and telnet, and remotely via a modem.

Power supply

Redundant power supplies provide mission-critical reliability. Dynamic load balancing between supplies and integrated UPS functionality offer ultimate failure protection.

Flexible LAN modules

The router needs to be user- or vendor-configurable for any network. Expect support for all flavors of Ethernet, Token-Ring, FDDI, and ATM, with a good assortment of ports.

Modular architecture

New protocols and network types mean upgradability is recommended even for workgroup routers. Favor routers where CPU, firmware, and network interfaces are on hot-swappable modules for easy insertion and removal.

Choice of WAN hardware/software

The perfect departmental router will let you select from packet-switched networks (Frame Relay, X.25), leased-line connections (56Kbps, Fractional T1, T1), and the switched-circuit networks (ISDN, Switched 56, and switched analog).

LCD panel and LEDs

An LCD panel should update the status of the router. No one should have to decipher lights, but well-labeled LEDs are valuable for information at a glance.

Powerful CPU and sufficient RAM

The CPU and memory should be sufficient to route packets at the capacity of the wire. We recommend 14,400 packets per second for a router with two Ethernet ports and one WAN port.

Rack-mountable

While optional for smaller installations, the perfect router must be rack-mountable.

Each router vendor's product typically uses special techniques called *routing protocols* for router-to-router communications, so you'll buy routers at least in pairs. These routing protocols include the routing information protocol (RIP) and open shortest path first (OSPF) used with TCP/IP based networks, Cisco's Interior Gateway Routing Protocol (IGRP) and Novell's new Net-

Ware Link Services Protocol.

Central-site or *enterprise* routers have multiple WAN ports, and some companies combine the routers with switches for high efficiency. *Peripheral departmental routers* provide less discrimination over what they send over the WAN link but offer lower cost. Peripheral routers in branch offices communicate with enterprise routers. Router costs

vary widely, depending on the number of protocols the system handles and the types of connections provided for the WAN links.

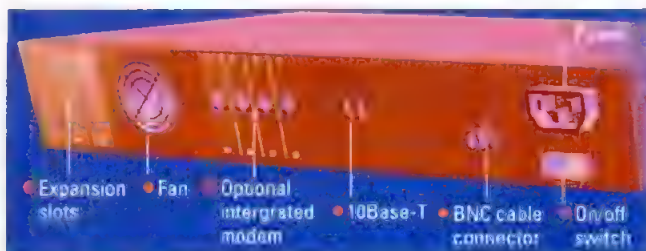
Like hubs, routers come in self-contained cabinets or in chassis. Typically, you'll want the flexibility of a chassis in your enterprise router so you can change modules to meet your needs, but the economy of the simple cabinet for

The PERFECT

REMOTE ACCESS

You should be able to connect as a node on the LAN (remote node) or remotely control a networked PC (remote control). Look to run multiple protocols over ISDN or standard phone lines.

Price: For four-port node server, \$7,000.

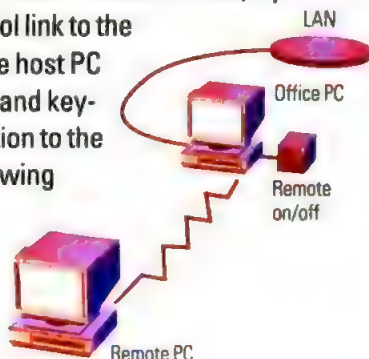


Network protocols

The more protocols the node server supports, the better. As a minimum look for AppleTalk, IPX, and TCP/IP support in the server and client. The perfect remote-access server will also connect to all flavors of Ethernet, Token-Ring, and FDDI and have at least four modem ports.

SINGLE-USER REMOTE ACCESS

If a single user needs remote access, try a remote-control link to the desktop PC. The host PC passes screen and key-stroke information to the remote PC, allowing transparent functionality and LAN connectivity.



remote or small-office routers is compelling.

Our perfect departmental router has the processing power to offer high capacity and flexibility and the programming to handle many network protocols intelligently. The perfect system will also include remote management through SNMP and on-board LEDs or LCD screens showing operational reports.

Security

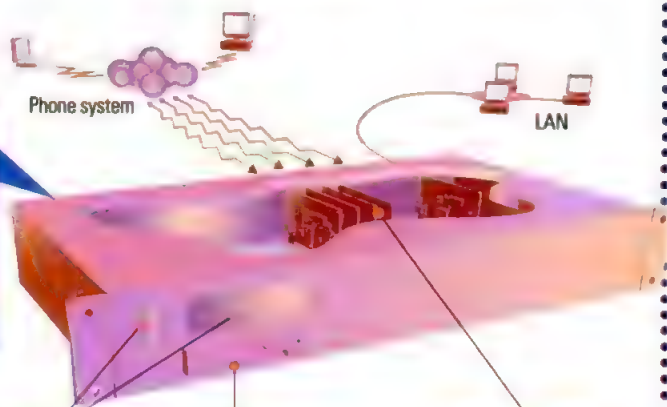
Look for products that offer Challenge Handshake Authorization Protocol (CHAP) and Password Authentication Protocol (PAP) support, capability to dial back to preset numbers, and password encryption.

Client software

To provide the most flexibility, the remote client should let a user either connect as a node on the LAN (remote node) or control a networked PC (remote control). Icons should launch applications using remote control or remote node transparently.

Central management

Expect the administrator to be able to set size limits on files and time limits on remote users. Managing the server through a modem or across the network with Simple Network Management Protocol (SNMP) is crucial as well.



LCD and LEDs

The LCD provides information on connections, including active ports. Well-labeled LEDs are valuable for information at a glance.

Floppy disk drive

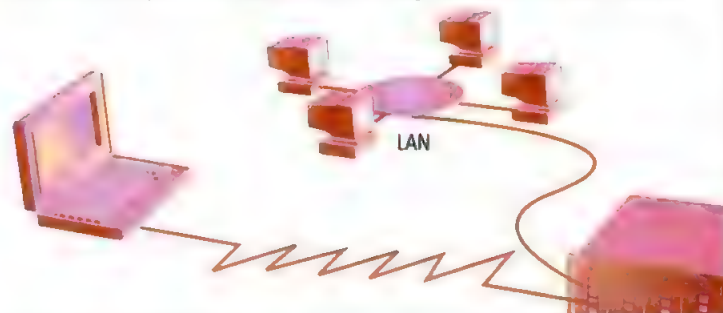
The server should include a floppy disk drive for easy installation and updating of remote-node server software.

Integrated modems

For ease of installation and configuration, you might choose integrated modems with flash memory for firmware updates.

COMMUNICATIONS SERVER

Eight or more simultaneous remote-control users calls for a communications server. In effect, its chassis houses multiple PCs and lets you manage them through SNMP. **Price: \$15,000.**



REMOTE ACCESS

Remote-access servers extend the network using modems and telephone lines. Access servers come in two basic types—remote-control and remote-node—but some systems combine both.

Under remote control, a calling PC remotely controls a distant PC. The caller sends keystrokes through the modem to a networked computer and the computer

sends images of its screens back to the caller. The programs execute on the host PC, so the power or storage of the remote PC isn't critical. You may find printing and transferring files a bit disconcerting, since your C drive is the drive of the remote system and not your local drive. Popular remote control programs, typically priced at under \$200, include Microcom's Carbon Copy, Norton-Lambert's Close-Up, and

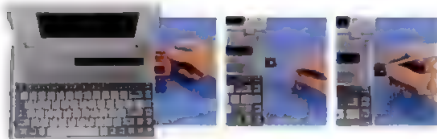
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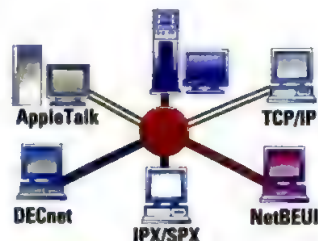
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CIRCLE 321 ON READER SERVICE CARD

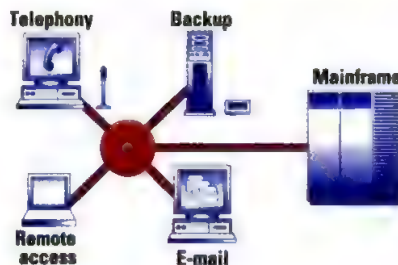
The PERFECT NOS

A network operating system (NOS), such as NetWare, extends the operating system so devices can share files and other resources on the network. Among other things, the perfect NOS must offer strong connectivity, reliability, scalability, and great file and application service.



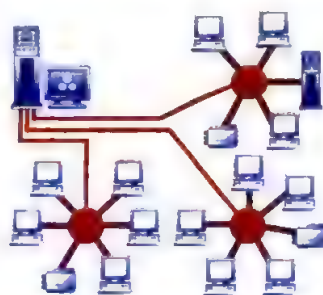
Connectivity

The NOS should simultaneously communicate over multiple protocols such as AppleTalk, DECnet, IPX/SPX, NetBEUI, and TCP/IP. The perfect NOS can use drives formatted with a variety of file systems.



Modular architecture

The perfect NOS should allow you to add hardware and software to your network easily. Additional network services—including telephony, backup, e-mail, mainframe connectivity, and remote access—should be easy to install and configure networkwide.



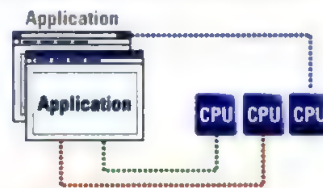
Scalability

From the smallest five-person workgroup to the largest network, the NOS must provide consistent features. Managing the perfect network requires a strong and stable global directory service—a database that maintains all information including users, groups, servers, volumes, and printers.



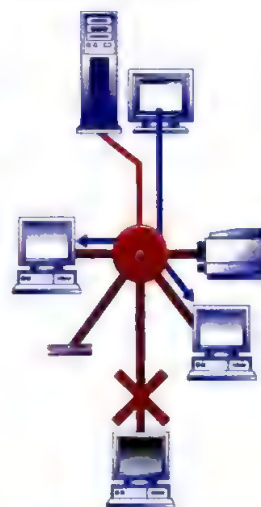
Diversity

The NOS should service requests from client PCs on different platforms. DOS, Macintosh, Microsoft Windows, OS/2, and Unix systems must connect easily to the network and share all network resources.



Performance

The perfect NOS provides several key features for servicing file requests and running client/server applications, including advanced memory management techniques, multitasking, preemptive multithreading, and multiprocessing.

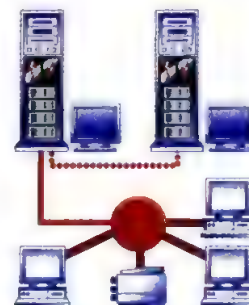
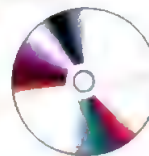


Resource sharing

Besides sharing files and printers, the perfect NOS can share modems, applications, and other resources across the network. Complete security includes passwords (for files, users, and groups), with system intruder detection and the ability to lock out a suspected intruder.

Simplicity

The perfect NOS is easy to install and reconfigure. It boots up and installs from a CD-ROM and auto-detects server hardware. For easy administration from one common interface, a GUI with drag-and-drop functions is a must. You should be able to add users and groups easily by granting them access rights to devices. This can be done from one common interface. Ideally, you should also be able to add new network protocols without having to bring down the server.



Reliability

Fault tolerance for the server should be included: System-disk duplexing, mirroring, and striping offer internal redundancy and complete system duplication to assure total safety for your networked data.

Symantec's pcAnywhere. Any PC can work under remote control, but companies like Cubix and J&L offer special hardware for the task. You can invest between \$4,000 and \$20,000 for these products, depending on the number and type of processors.

Remote-node connections are a true extension of the network across a modem and rely on powerful calling computers with networking software installed.

Callers see network drives and printers on their laptop computers just as they do through a local LAN connection.

You can pay almost any price for a remote-node server. Remote-node server software comes bundled in Microsoft Windows NT. Remote-node client software will be included with OS/2 Warp Connect and Microsoft Windows 95. Companies such as Microcom, Shiva, and U.S. Robot-

ics offer remote-node server and hardware bundles. The appropriate client code is also included, and the total package can run about \$1,000 per incoming port.

The criteria of capacity and flexibility apply to remote-access servers. An eight-port device with good processing power and the ability to work with PC and Macintosh computers describes our choice. This product should at least support the IP and

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CIRCLE 069 ON READER SERVICE CARD

The PERFECT LAN BACKUP

The perfect backup system stores critical files efficiently and cost-effectively. Users should be able to get to the stored files quickly and transparently.

Price: Hardware, \$2,000; software, \$1,000 per server.

Tape auto-changers

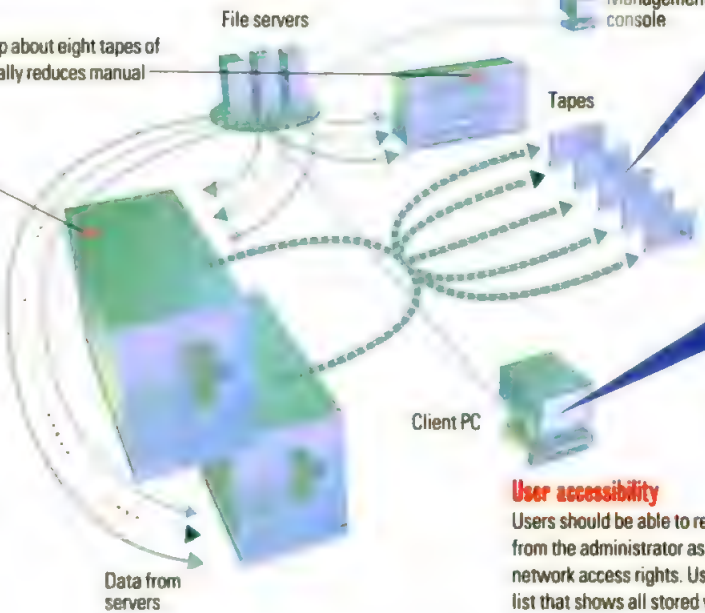
Tape auto-changers automatically swap about eight tapes of about 4GB each for DAT. This dramatically reduces manual intervention.

Multiple drives and media

The backup software should simultaneously manage multiple tape drives and interleave multiple sessions on a single tape for maximum performance.

Integrated HSM

A hierarchical storage management (HSM) system automatically causes seldom-used data to migrate to more cost-efficient optical disks. Users access files without knowing whether they reside on a hard disk or an optical drive.



Central administration

The backup administration software schedules and monitors all backup jobs throughout the enterprise. The software tracks every tape's location and notifies the administrator when tapes need to be changed.

User accessibility

Users should be able to restore files without requesting them from the administrator as, long as the files are not restricted by network access rights. Users should be able to access a unified list that shows all stored versions of a file from any tape set.

IPX networking protocols, be able to take full advantage of V.34 modems, and drive all communications ports at 115.2 Kbps.

NETWORK OPERATING SYSTEM

The network operating system (NOS) is the software that provides the means for sharing resources. Some products, such as Novell's NetWare 3.12 and 4.1x, clearly separate the client and server software and functions. But one PC can play both roles, as do Microsoft Windows for Workgroups and Windows NT and Artisoft's LANtastic. Windows 95 and IBM's OS/2 Warp Connect will also include the necessary software

to act as a client or as a server and client simultaneously. (For an in-depth look at modern NOSs, refer to "Hooked and Linked," May 16, 1995.)

The perfect NOS tunes the server by managing memory and allocates tasks across multiple processors, providing *scalability*, or the ability to grow. The NOS includes management functions to improve

its reliability and uses disk file formats and caching techniques that give fast access. Our perfect package includes client software that works with server software from different companies and can flexibly use protocols such as IPX and IP. In networks with multiple servers, the perfect NOS should offer a single password log on for all services—a scalability function called a *di-*

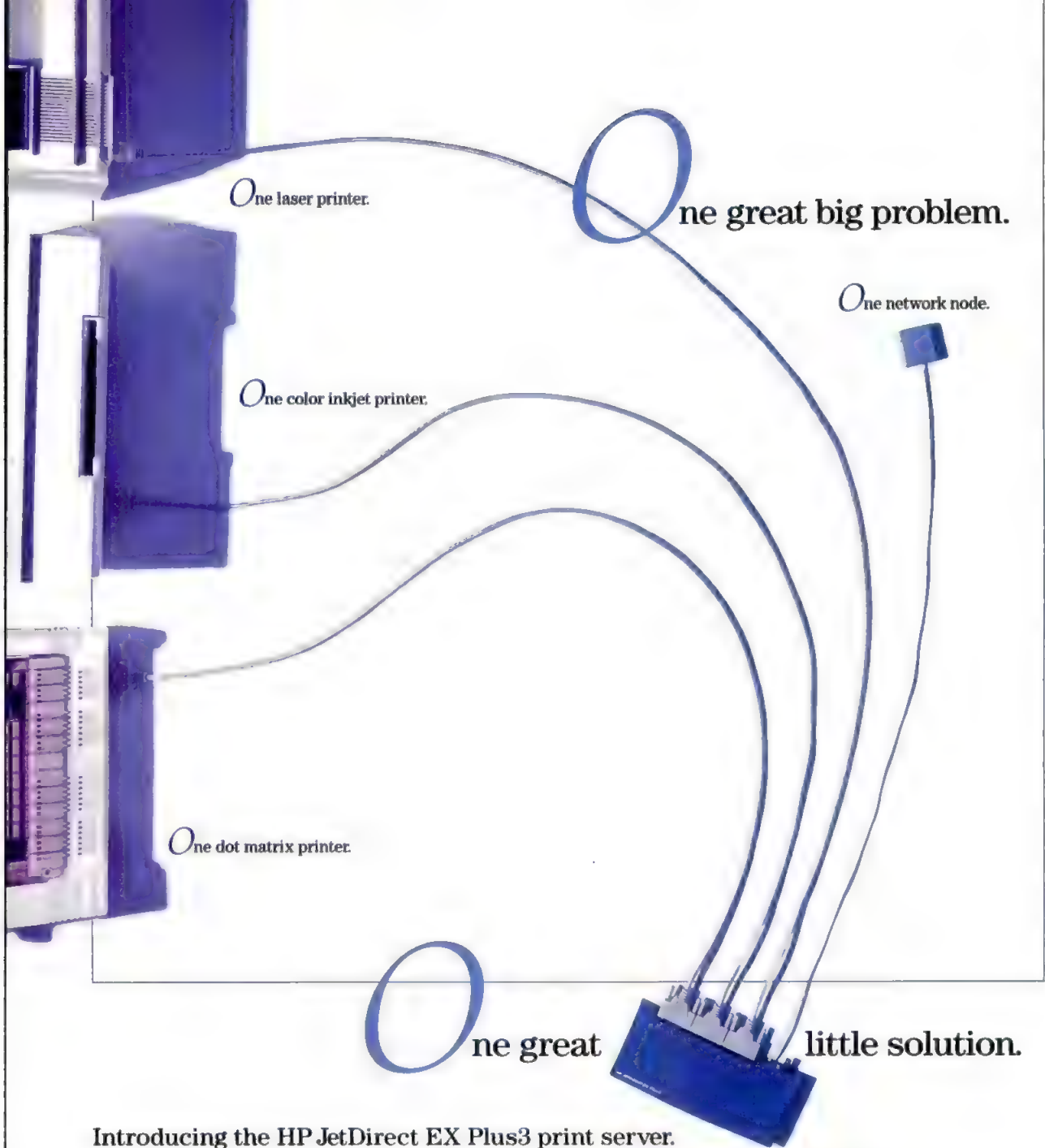
rectory service that is found in NetWare 4.1 and VINES.

THE PERFECT BACKUP MEDIUM

Type	Description	Media capacity	Drive cost	Advantages	Disadvantages
Compact disk-recordable (CD-R)	CD technology that uses a laser to read and write to CD-ROMs	650MB	\$3,000 to \$8,000	Extended lifetime, can read data directly from backup media	High drive cost, cannot be overwritten, low capacity
Digital audio tape (DAT)	4-mm digital magnetic-tape technology that uses the helical-scan recording method	2GB to 4GB	\$800 to \$1,700	High capacity, fast, low drive and media costs	Has neither the speed nor the capacity of 8-mm tape or DLT
Digital linear tape (DLT)	Simultaneously records and reads multiple channels	6GB to 40GB	\$3,100 to \$25,000	High capacity, fast; very low media cost	High drive cost
8-mm helical scan	Technology that uses the helical-scan recording method	2.5GB to 7GB	\$1,400 to \$2,500	High capacity, fast; very low media cost	High drive cost
Magneto-optical	Combined laser and magnetic method to write, and a magnetic method to read	200MB to 250MB	\$850 to \$1,200	No extra software, low drive cost, reads data directly from media	High media cost, low capacity
Full-size quarter-inch cartridge (QIC)	Magnetic tape technology that uses the serpentine recording method	60MB to 5GB	\$1,200 to \$3,500	High capacity, low media cost	High cost

BACKUP AND ADMINISTRATION

The data shared on a network is a valuable resource in need of protection. Our perfect network has strong backup and administration features. Perfect backup systems can handle mul-



Introducing the HP JetDirect EX Plus3 print server.

Now you can connect up to three parallel printers to a single network node.

Your office has all kinds of printers, and all kinds of printer configurations, all of which can change daily. And it's your job to hook them all

up to the network. With a limited number of nodes, that can be a big problem.

Fortunately, there's an easy way out—and in. The new HP JetDirect EX Plus3 print server lets you connect up to three printers to the

network, using only one LAN connection. Best of all, it works with any parallel printer, and supports virtually every network protocol and NOS out there.

For fast faxed information, call 1-800-964-1066.* You'll discover that for every problem, there's a solution. At least when it comes to network printing.

NOS Compatibility: Novell NetWare; Microsoft® Windows™ 95, Windows NT, Windows for Workgroups, LAN Manager; IBM LAN Server; UNIX®; HP-UX, SunOS, Solaris, IBM AIX, SCO UNIX, Ipd; Apple EtherTalk

Management Support: HP JetAdmin print management software enables consistent installation and management of any HP JetDirect connected printer on the network;

supports SNMP-based network management software

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PRICE • Each year, MaxTech produces over 5 million communication products in its five ISO-9002 certified plants. This buying clout and production efficiency enables us to deliver high quality products with "value-added" features at the lowest possible price.

Modems • All MaxTech and GVC modems are engineered for throughputs up to 50% faster than other brands. And, each modem is packed with extras, such as call-back security, voice features, free fax/data software and a complete on-line service package.

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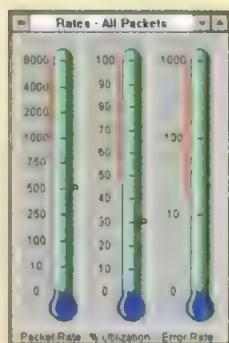


The PERFECT ADMINISTRATION APPLICATION

Maintenance is a necessary evil, but a good administration application makes it much easier. The perfect administration application offers an extensive suite of tightly integrated, easy-to-use proprietary and third-party tools. **Price: For 50 users, \$2,500.**

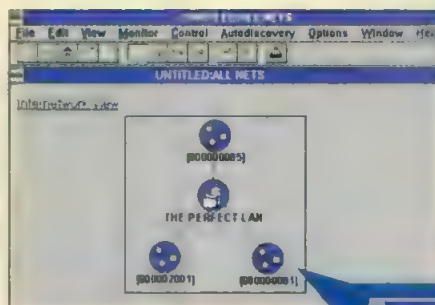
Network statistics

Network performance figures for each client and server should be displayed graphically. The application should produce customized, exportable reports. Threshold limits for multiple parameters should be easily configurable.



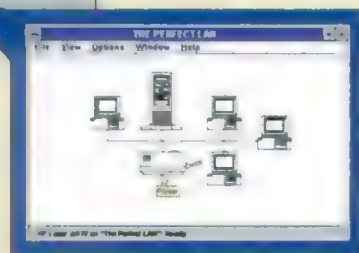
Network management platform

The main management platform should be able to monitor internetwork resources using the Simple Network Management Protocol (SNMP).



Automatic network mapping

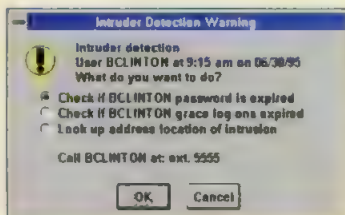
The application should automatically map network topologies and provide real-time, point-and-click troubleshooting features.



Hardware and software inventory

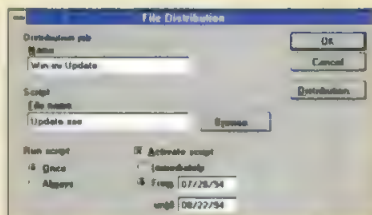
A central database should store information about all hardware and software on a given client.

Server	Last User	Station	Part
1. NETMGMT1	STEVE	00001B27333E	BASEMEMORY
2. NETMGMT1	STEVE	00001B27333E	BUS
3. NETMGMT1	STEVE	00001B27333E	BUSTYPE
4. NETMGMT1	STEVE	00001B27333E	COPROCESSOR
5. NETMGMT1	STEVE	00001B27333E	CPU
6. NETMGMT1	STEVE	00001B27333E	EXPMEMORY



Problem notification

Critical network conditions and suggested solutions should be reported to the administrator via the main console, e-mail, fax, or pager.



Software distribution

This feature relieves the administrator of visiting every user's PC for installation and upgrades; it is mandatory for bug fixes and driver updates.

Product	Licenses	Licenses in Use	Enforce License
Microsoft Windows	10	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes
Microsoft Windows	1	0	yes

Software metering

The application must allow the administrator to enforce a license, or it must notify the administrator when the maximum number of licenses is reached.

multiple servers and conduct automated backup sessions. Backup includes the ability to move unused files from hard disk drives out to long-term tape or writable CD storage—a technique called *hierarchical storage management (HSM)*—and the ability to use many different types of tape drives and tape changers. Cheyenne, Conner, Legato Systems, and Palindrome have been the leaders in HSM technology.

Modern network-administration products include suites of software that can inventory and track the hardware and software on your LAN, kill viruses, report server problems, and generate statistical reports on network operation. These products include BrightWorks from McAfee Associates, The Frye Utilities for Networks, and Norton Administrator for Networks. The prices vary widely depending

on the modules you use and the number of clients, but we suggest initially budgeting about \$50 per client for administrative software. Network management software that manages the infrastructure, such as OpenView, can be substantially more expensive.

When you connect many different pieces, each chosen for its capacity and flexibility, into a single network, the results are close to perfect. □

Building the Perfect Internet Toolkit

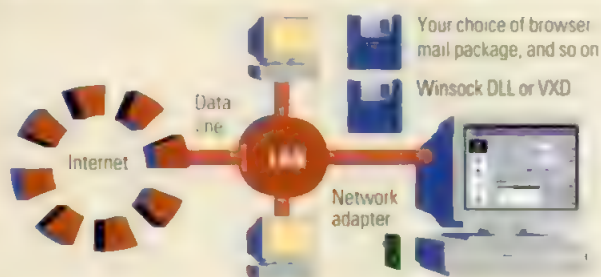
It's the most powerful communications force to evolve in our generation. Tens of millions are already on the Internet; when will *you* join them?

By Ted Stevenson

The PERFECT INTERNET CONNECTION

Dramatic improvements in Internet software—including turnkey end user solutions and improved on-line service offerings—bring no-sweat access to all of the Internet.

LAN-BASED CONNECTIONS



The tools:

- Network adapter connecting your PC to a LAN running TCP/IP software
- Switched 56-to-T1 data line connecting your LAN to the Internet
- Winsock DLL or VxD, so you can run Windows apps. It may be shareware or a version distributed with Win95 3.11, Windows NT, or with apps themselves
- Your choice of applications (any browser, mail package, and so on)

Pros:

- This is generally the fastest possible connection. Performance bottlenecks are more likely to be in your PC (in the

display adapter, for example) than in data throughput

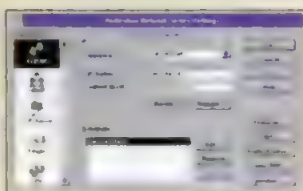
- You are not restricted in your choice of applications

Cons:

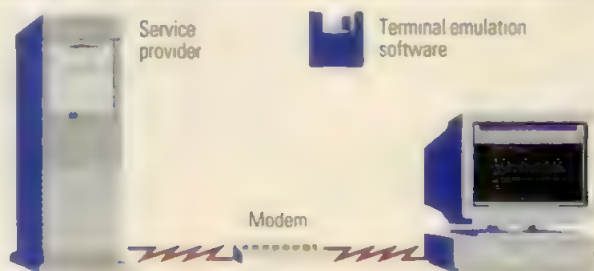
- Even professionals have trouble getting these connections running. You need to know IP addresses for domain host, and gateway servers and each system on your LAN. You also need to know your LAN's hardware, software, and TCP/IP configuration (ports, interrupts, DMAs, network speed, and network type)

The experience:

It doesn't get any better—once you have the system working. You're free to choose your own apps, explore the World-Wide Web, receive mail, and download files. Best of all, for most LAN-connected users it's free.



UNIX SHELL CONNECTIONS



The tools:

- Modem.
- Shell account from a service provider on a Unix host.
- Terminal emulation software.

What's not involved:

- TCP/IP or Winsock software, network adapters, or complex setup

Pros:

- This is the cheapest dial-up access—as low as \$7 to \$9 per month for unlimited use
- Connecting is as easy as with any other modem link

- Since Unix shells are command line-based and text-mode only, service is pretty fast

Cons:

- Unix is text only, there are no graphics on Gopher or World-Wide Web connections
- Operation is via command line, there is no navigation or other help from client software
- You have to learn Unix commands

The experience:

Unix shells are cheap and bland, although they represent the majority of Internet connections today. They're good for FTP operations, okay for mail and news, and marginal for Gopher searches and the Web.



The Internet is both complex and simple: It's built on myriad server technologies and communications protocols, but in the end, it's simply serving up information—in a stimulating variety of forms and flavors. The simple side of the Internet is actually just beginning to emerge today, thanks to a software industry determined to tame and harness this powerful force—and to make lots of money in the process. In the following pages, we'll explore tools,

some very real, some imagined, that help you tap the vast riches the Internet offers.

At the dawn of the era of mass Internet popularity, getting connected required technical skill and perseverance, and many of us turned to the professional network gurus to get the job done. Today, anyone with the know-how to install a modem and subscribe to an on-line service can experience the delights—and frustrations—of the In-

ternet (although for the time being they may experience it with possible limitations, depending on the service they have chosen). Unix shell accounts and SLIP or PPP accounts offer additional alternatives for those with different capacities, requirements, and resources. So what kind of connection is most appropriate for *you*? Explore with us the tools you'll need, the pluses and minuses, and the overall experience you'll get with each of the four choices available

As you move through the spectrum of connection solutions, from LAN-based links to on-line service hookups, you also span a setup and performance continuum. From left to right, connections become slower but easier to use.

**Easier setup,
slower performance**

SLIP AND PPP CONNECTIONS



The tools:

- Modem.
- Dial-up account with a SLIP or PPP service provider.
- SLIP or PPP, TCP/IP, and Winsock client software on your PC.
- Your choice of applications (any browser, mail package, and so on).

Pros:

- SLIP and PPP are easier to configure than LAN connections.
- They provide reasonable speed with a 14.4-Kbps connection and excellent speed with a 28.8-Kbps connection.

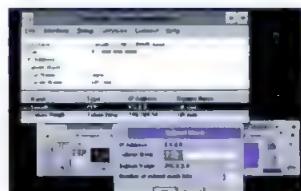
- You get access to the full range of Internet services; you're a full peer on the Net.
- You can access graphics, audio, and video.

Cons:

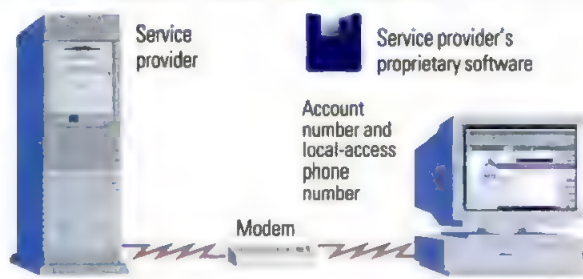
- Unless you pick one of the few turnkey solutions, you must know and enter IP addresses for domain, host, and gateway servers during setup.
- At \$20 to \$25 per month for unlimited service, these accounts are pricier than Unix shell connections.

The experience:

These are robust and affordable connections for those who can get past setup. You can use any client software to access any and all services. With 28.8-Kbps service, SLIP or PPP will feel as fast as a LAN connection.



ON-LINE SERVICE CONNECTIONS



The tools:

- Modem.
- Account number and local-access phone number.
- Service provider's proprietary software (included with account).

What's *not* involved:

- TCP/IP or Winsock software, network adapters, or complex setup.

Pros:

- Commercial on-line services offer the easiest setup; there's nothing to buy and no configuration problems.
- They also have simple, easy-to-use

menu-driven graphical software.

- You get easy access to most or all Internet resources.
- You get the non-Internet content that each service provides.

Cons:

- These can be the most expensive roads to the Internet. Base charges run about \$10 per month and include 3 to 5 hours of Internet access. Beyond that, you pay anywhere from \$1 to \$4.50 per hour to surf the Net.

The experience:

On-line services are slow, safe, and expensive but offer the luxury of ease. They're also potentially limited: Some don't yet offer graphical access to the Web. As 28.8-Kbps service spreads, speed will cease to be a problem.



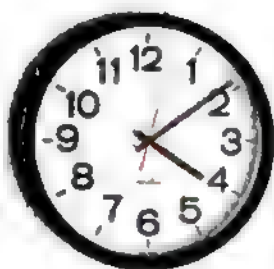


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**PORTÉGÉ™
610CT**

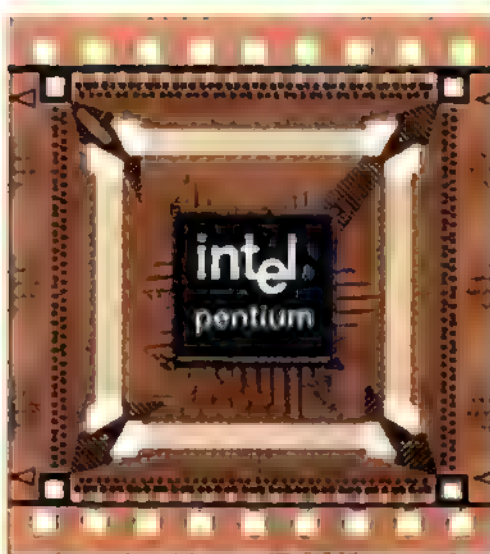
720 Million Byte HDD, a large 9.5" diagonal color display, two stacked PC Card slots, a captivating sound system and an optional Port Replicator for one-step connection to your desktop. See how far Toshiba has taken every aspect of portable computing. And think where it can take you. Call 1-800-457-7777 for your nearest dealer.



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PC Card expandability. Two stacked PC Card slots (two Type II or one Type III) leave your options for storage, fax/modems, networking and the future wide open.



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- Integrated 16-bit Sound Blaster™ compatible sound system
- New enhanced Lithium Ion battery
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In Touch with Tomorrow
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CIRCLE 379 ON READER SERVICE CARD

THE PERFECT PC
The Perfect Internet Toolkit

today for making the perfect Internet connection.

Once you've solved the Internet-connection puzzle, you can move on to the end-user software puzzle. Until recently, a full kit of Internet software tools contained no fewer than eight separate client applications (plus a smattering of utilities)—programs that evolved at the grass-roots level of

the Internet community to handle new Internet services as they evolved. Today, functions that used to require a dedicated application—for example, uploading or downloading files or launching a Gopher search—are increasingly built into larger, multipurpose packages. Not far in the future, we see users typically working with a single Internet software tool that will handle all

the protocols and processes involved in full Internet usage. In the graphic below, we take a crystal-ball look at how such a unified software tool might look and work.

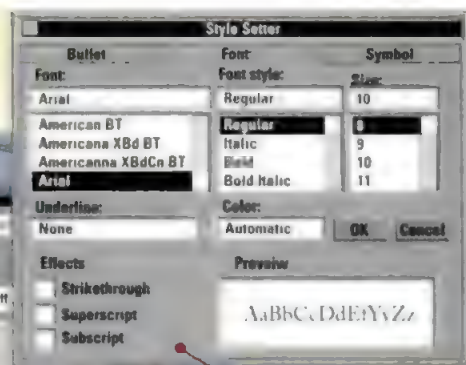
You'll notice that in our perfect Internet application we've consolidated some now-disparate operations that are conceptually similar, giving them a single point of access. (For example, a

The PERFECT INTERNET APPLICATION

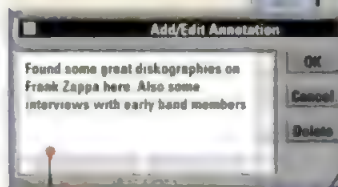
The shift from Internet shareware solutions to commercial products has improved the quality of software and has resulted in a consolidation of once-separate functions. Our ideal Internet application encompasses all of those functions in one package.

NAVIGATION TOOLS

Our Internet app provides tools to streamline the process of finding your way to sites that serve up the information you find compelling.

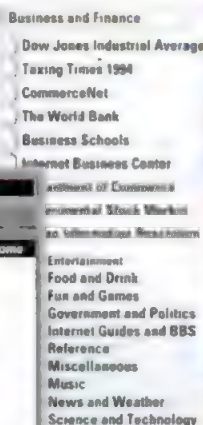
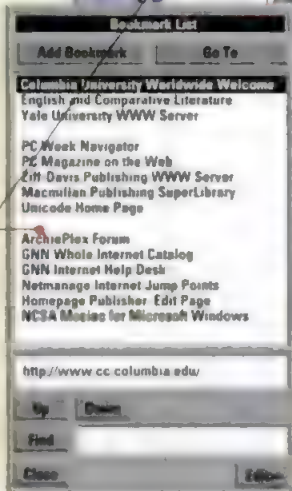


Thumbnails of Web pages can be dragged into the main viewing screen

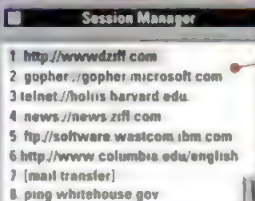


Annotations preserve additional information on selected pages

Bookmarks (hot list entries) can be edited and arranged in two different kinds of collapsible outline-style listings. Drag an entry to the thumbnails to open a miniature image while reading another page

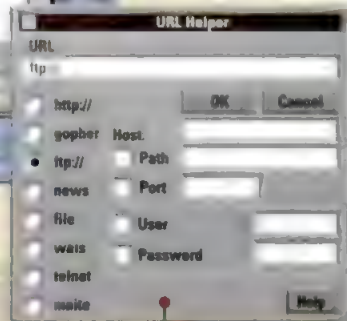


The Multiple Document Interface lets you cascade or iconize current pages.



Fonts and other document style elements can be rendered according to users' preferences

Session Manager displays all open connections, including PING, WHOIS, and other functions



The URL Helper aids in filling in the correct syntax and can search for a location name

search is now simply a search, not a Gopher search, or a WAIS search, or an archie search.) At the same time, based on our view that good software needs to offer users several ways of working, we've provided multiple interface tools for a number of important tasks. One primary focus of Internet interaction is getting places, hence much time spent on the Net is consumed with navigation:

quickly and efficiently finding your way to—and back to—sites that serve up the things you find compelling. Our Internet app provides a variety of tools to streamline and simplify saving, organizing, and annotating electronic road maps to places that you value most.

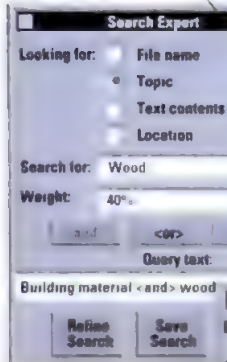
Another important Internet focus is finding specific information. A number of server-based tools—archie, Gopher,

Veronica, and WAIS, for example—already exist to help with information-searching. But much work remains to be done in speeding access to the huge volumes of information now on the Internet, let alone the immense deluge that will appear in the future. Our Internet application raises the bar in search methodology with such innovations as complex, weighted search targets and

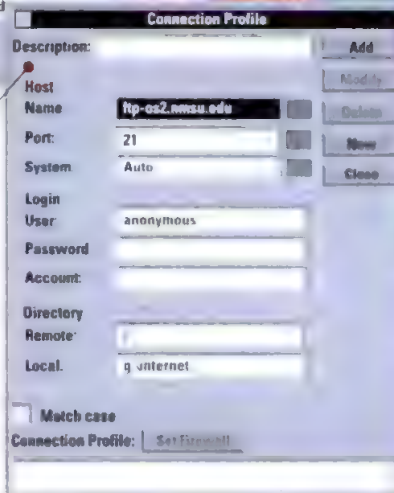
SEARCH TOOLS

Several search tools already exist, but our Internet app raises the bar in search methodology with such innovations as complex, weighted search targets.

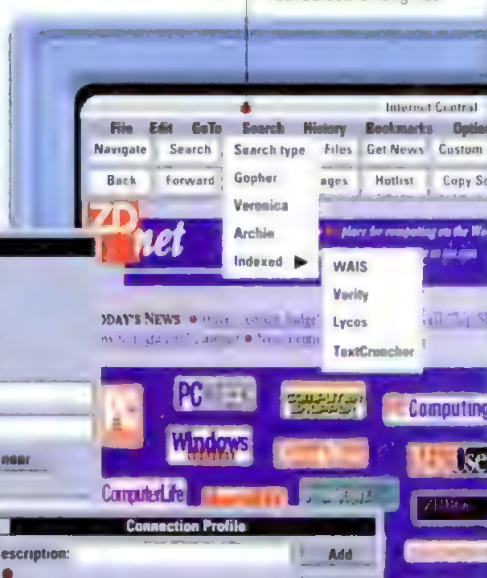
The Search Expert helps build queries for multiple types of searches, with individual weighting of elements and logical as well as proximity operators.



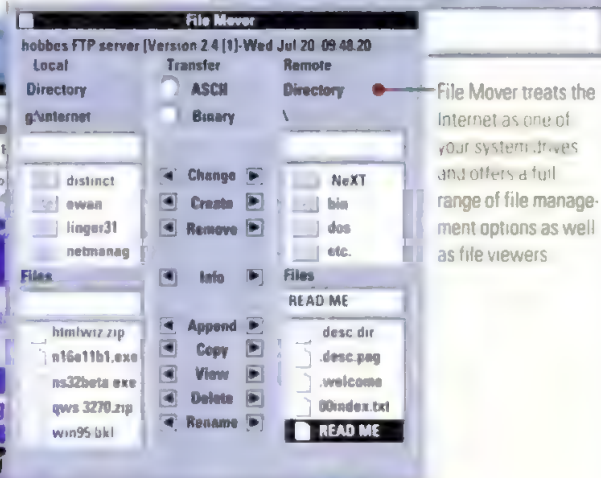
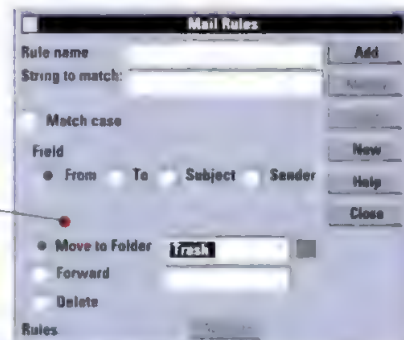
The Connection Profile dialog stores the information needed for automatic log-ons to remote FTP sites.



Customizable drop-down menus can be updated to accommodate multiple indexed-search engines

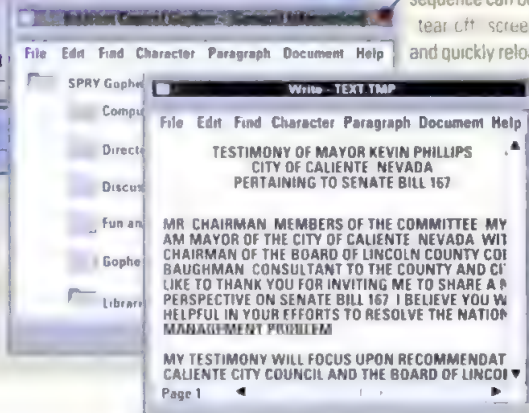


Agents automatically forward incoming mail and organize it into folders, based on date, subject, or sender



File Mover treats the Internet as one of your system drives and offers a full range of file management options as well as file viewers

Any stage of a search sequence can be kept as a tear off screen image and quickly reloaded



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INTERNET PUBLISHER

Along with commerce, publishing is the next major wave of Internet development. Companies and organizations the world over are rushing to grab some electronic-publishing real estate.

The tools

• **Server hardware and software:** Before embarking on Internet publishing, you'll need to make a fundamental choice between two technological platforms: Unix and Microsoft Windows NT.

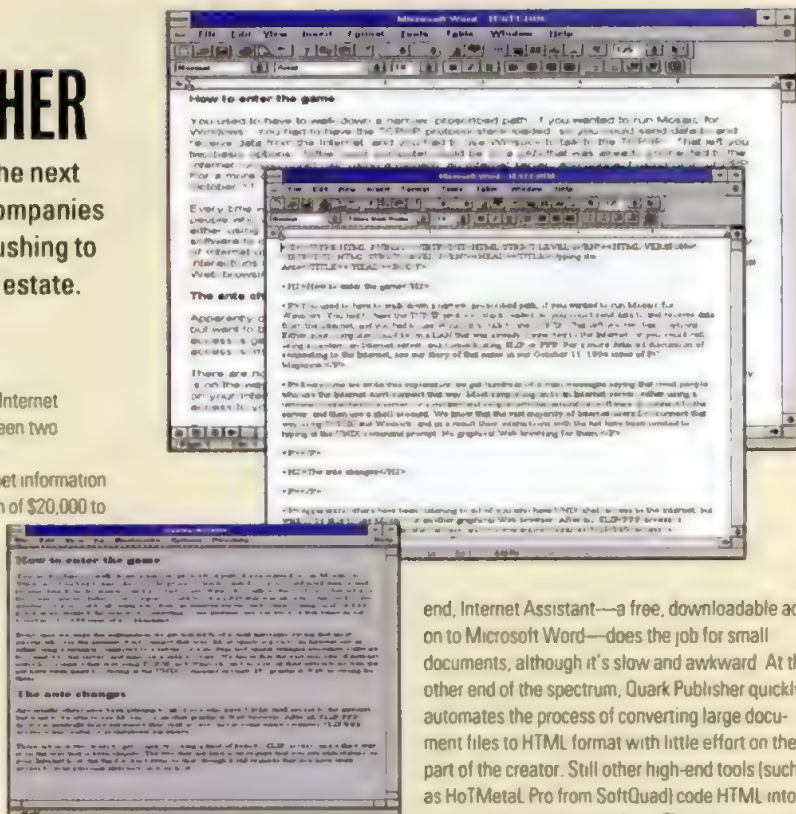
Unix: A Unix workstation running Unix versions of Internet information servers (such as a Web or Gopher server) will cost a minimum of \$20,000 to \$35,000. (Both Sun Microsystems and Silicon Graphics sell hardware/software bundles that include the workstation, the OS, and all the Internet software you need.)

Pros: Unix workstations have proven robustness, both in terms of server speed and the large connection loads they can handle. They also have many security and administration tools. **Cons:** You can expect a relatively high cost and demanding setup, configuration, and maintenance.

Windows NT: An Intel-based PC (with a 486 or Pentium CPU) running Windows NT and Windows NT-based server software (such as O'Reilly's NetSite or the Netscape Communications Server) will cost a minimum of \$4,000 to \$5,000. (To put together a Windows NT-based server, you'll need to purchase the hardware and the OS separately, but this shouldn't present a problem to most potential publishers.)

Pros: Windows NT workstations offer relatively low cost and ease of setup, configuration, and maintenance. **Cons:** Windows NT is new to the scene and hence relatively unproven by the test of time. (Keep in mind, though, that all of Microsoft's Internet services—including its FTP site, reputedly the busiest on the Internet—have been running successfully on Windows NT servers for many months.)

• **A pipe (dedicated phone line) to the Internet:** The minimum throughput necessary to support a viable Internet connection is provided by a Switched 56 line, which costs about \$1,000 per month, a T1 line with more than 27 times the throughput capacity will cost about \$3,700 per month.



CREATING CONTENT: A Web page begins as a simple text file (top). HTML formatting and hyperlink tags are then added (middle), enabling any Web browser to render the document as a fully formatted page (bottom).

Authoring options

Though content creators today typically hand-code HyperText Markup Language (HTML) tags into their documents, software tools to automate this process—by using built-in formatting stylesheets, file-specification dialog boxes, and the like—are appearing at a rapid pace.

The authoring tools available today run a wide gamut of cost and sophistication. (All support the inclusion of graphics, by the way, but they don't at this time support other in-line media like sound, video, virtual reality, and 3-D effects.) At the low

end, Internet Assistant—a free, downloadable add-on to Microsoft Word—does the job for small documents, although it's slow and awkward. At the other end of the spectrum, Quark Publisher quickly automates the process of converting large document files to HTML format with little effort on the part of the creator. Still other high-end tools (such as HotMetal Pro from SoftQuad) code HTML into documents as you create them. This gives you maximum control over the final appearance of your documents. Filling the middle ground will be an increasing number of midlevel authoring tools, such as Quarterdeck's WebAuthor. These may well be the choices of the future for nonprofessional content creators.

Security

One of the problematic facets of electronic publishing is that provider and consumer become electronically intertwined. When consumers visit providers' file servers, they have the opportunity to create potential mischief. Hence, *firewalls* (devices that isolate portions of your network, confining visitors to the public areas where you want them to be) are a concern to many publishers. (Firewall products are, for the most part, Unix-based software packages. They typically require their own server hardware.)

the ability to utilize the latest indexing technologies.

Finally, we see the Internet rapidly emerging as the dominant vehicle for the long-awaited blossoming of electronic publishing. Of course, concepts, tools, and techniques for publishing electronically have been rolling off the software production lines for a number of years now, but until the absolute explosion of interest in the Internet, the venues were

all essentially proprietary—and quite expensive.

Over the past year or so, the Net has been at the center of many important developments that enable both ends of the electronic publishing process: producing publications and accessing them. Far from slackening, this development tide is gaining strength. It is moving us ever more rapidly toward a world in which virtually anyone with the motiva-

tion will be able to manage and afford the process of making their publications—complete with images, sound, and even video—available to tens of millions of Internet users. In the graphic above, we explore the basic whys, whats, and hows of getting into the Internet publishing game by touching on what tools you'll need, how to create content, and what security issues you may confront. □

Service & Reliability: Are You Getting What You Need?

Which PC vendors provide their customers with the most reliable systems backed by the best service and technical support? Our subscribers rate 38 of the top desktop and notebook manufacturers.

By Rachel Derby Teitler and Carol Venezia



There's no question that today's PC market gives the buyer the best of everything: More vendors are offering more for your dollar than ever before. And rapid-fire advances in technology are also bringing lower system prices faster.

What this scenario also means is that as the market becomes more crowded, vendors are looking for ways to distinguish themselves. Many of them are now extending warranties and enhancing service and support policies.

To find out which vendors our readers feel provide the most reliable PCs backed by the best service and support, we send 17,000 subscribers our Service and Reliability survey. This survey allows us to learn about our subscribers' experiences with the PCs they've used and their impressions of the quality of support that they've received.

NEW METHODOLOGY

As in previous Service and Reliability surveys, our Readers' Report Cards take into account ratings of:

- Satisfaction with reliability.
- Satisfaction with repair experience.
- Satisfaction with technical support.

To this we now add a fourth key measure—units needing repair in the first year—which is the percentage of PCs rated by subscribers that required one or more repairs during the first 12 months

of use (hereafter referred to as "first-year repair"). In the history of our Service and Reliability surveys, this is the first time that we've had a direct measure of *product reliability* by which to gauge the vendors that our subscribers rate.

These four measures are now the basis for our Readers' Report Cards and Readers' Choice awards.

For this survey, our Readers' Choice awards—indicating signifi-

cantly better-than-average scores on all four key measures—belong to:

Desktop PCs (4): Compaq, Digital Equipment Corp., Hewlett-Packard, and IBM.

Notebook PCs (2): Compaq and Toshiba.

We also ask respondents to rate their likelihood of purchasing a new PC from the same vendor. This measure is discussed but is not considered when calculating Readers' Report Card grades.

HOW WE GRADED

Letter grades of A, B, C, D, or E, as shown in our Readers' Report Cards, are assigned to each vendor based on the vendor's scores on the four key survey measures. Grades are calculated in the following manner:

A: The vendor is better than average on all four key measures.

B: The vendor has a combination of better-than-average and average scores.

C: The vendor has four average scores or a combination of scores (better-than-average, average, worse-than-average) that together yield an average grade.

D: The vendor has a combination of average and worse-than-average scores.

E: All four scores are worse than average.

THE BIG PICTURE

Survey participants reported on nearly 21,000 desktops and more than 5,400 notebooks used in the past two years. Among the 35 desktop PC vendors we

READERS' REPORT CARD	
Notebook Systems	
Grade	Vendor
A	Compaq Toshiba
B	Gateway Hewlett-Packard IBM NEC
C	Apple AT&T GIS Dell Digital Epson Packard Bell Tandy Texas Instruments ZEOS
D	AST Austin Bondwell GRID MidWest Micro ZDS
E	CompuAdd

report on, one vendor is new to this survey: USA Flex. On the notebook side, 3 of the 22 included vendors are new to this survey: Austin, Packard Bell, and Mid-West Micro.

Average scores for desktops and notebooks on our three satisfaction questions remain consistent with our previous survey. (For details, refer to our issue of January 10, 1995.) For desktops, the average score for satisfaction with reliability in this survey is 7.8; for satisfaction with repair experience, 7.4; and for satisfaction with technical support, 7.0. Average scores for notebooks are 7.9, 6.9, and 7.1, respectively.

Our new first-year repair question brings some intriguing results. Several of the large direct-mail vendors do not perform as well relative to the average as vendors with a major retail presence.

Desktop vendors earning a better-than-average score for first-year repair include: Compaq, Digital, HP, IBM (our four Readers' Choice winners), ALR, Apple, AST, NEC, and Packard Bell. In contrast, Dell, Gateway, and Micron (all previous Readers' Choice winners) are only average performers on this measure. The vendors that are the poorest performers on this measure are Austin, CompuAdd, Northgate, PC Brand, USA Flex, and ZEOS—all with worse-than-average scores.

NO LONGER WITH US

Although we continue to publish their results as a point of reference, several vendors that appear on our survey have gotten out of the desktop business. These vendors include Samsung, Tandy, Wang, and Wyse. Three vendors—Bondwell, GRiD Systems, and PC Brand—have gone out of business altogether.

Samsung has been out of the desktop PC business in the U.S. since February 1994, but the vendor is still selling monitors and portable PCs.

Since AST purchased Tandy's PC manufacturing business, the Tandy brand name has been phased out. Radio Shack stores (which previously carried Tandy-labeled systems) now carry systems from AST, IBM, and Packard Bell.

Both Wang and Wyse no longer manufacture desktop PCs. Wyse continues to

market terminals and monitors, while Wang is still active in the areas of mini-computers and application and system-level software.

PC Brand went out of business in 1993. All parts and service requests for PC Brand computers are now being handled by Sierra (Racine, WI; 800-722-7263).

READERS' REPORT CARD	
Desktop Systems	
Grade	Vendor
A	Compaq
	Digital
	Hewlett-Packard
	IBM
B	ALR
	Apple/Macintosh
	AST
	Dell
	Gateway
	Insight
	Micron
	MidWest Micro
	NEC
C	Acer
	Compudyne
	DTK
	Northgate
	Packard Bell
	Samsung
	Tri-Star
	ZEOS
D	AT&T GIS
	Austin
	CompuAdd
	Epson
	Everex
	Hyundai
	Leading Edge
	PC Brand
	Tandy
	Unisys
	USA Flex
	Wang
	Wyse
	ZDS

THE DESKTOP A-LIST

It is now more difficult for vendors to earn A's on our Readers' Report Cards than in previous surveys. To earn an A this time, a vendor must receive significantly better-than-average scores on each of the old survey measures—satisfaction with reliability, satisfaction with repair, and satisfaction with technical support—and a better-than-average score on our new first-year repair measure.

Compaq, Digital, HP, and IBM meet this challenge and earn better-than-average scores for future likelihood of buying.

THE B VENDORS

Other noteworthy desktop vendors are those that earn a grade of B on our Readers' Report Card: ALR, Apple, AST, Dell, Gateway, Insight, Micron, MidWest Micro, and NEC. With the exception of ALR and NEC, each also receives a better-than-average score on future likelihood of buying.

Dell, Gateway, and Micron each continue to receive better-than-average scores on our three satisfaction questions. But on our new first-year repair measure, all three vendors receive average scores.

AST's scores for both satisfaction with reliability and satisfaction with repair experience improve from our previous survey to better than average. The company also enjoys a better-than-average score on first-year repair. In the past year, AST doubled the number of people that staff its in-house technical-support lines and began outsourcing some support calls. These measures were taken to deal with the increase in phone traffic that AST has seen from retail purchasers.

In April, AST announced a 24-hour, 7-day spare parts service in partnership with PC Service Source of Dallas, Texas. Through this service, customers can order accessories, options, and upgrades for AST systems.

Of the remaining B vendors, several show improvements relative to our last survey on the old measures, while some shine on our new first-year repair measure. For ALR, not only do its scores on satisfaction with repair experience and with technical support both improve to average, but its score on first-year repair is better than the average.

Two other B vendors with significantly better-than-average scores on our first-year repair question are Apple and NEC. Of all Apple systems rated, only 15 percent required at least one repair during the first 12 months of use—about half the desktop vendor average of 28 percent. For anyone who has used a Macintosh, the reason for this superior score is apparent: True plug-and-play capability has al-

How Readers Rated PC Vendors

▲ = Significantly better than average ● = Average ▼ = Significantly worse than average

Vendor (and number of responses)	Units needing repair in first year	Reliability	Repair	Tech support	Buy again?
DESKTOP					
Acer (343)	26% ●	7.8	7.2	6.8	6.5 ▲
ALR (182)	21% ▲	7.8	7.2	6.9	6.0
Apple (608)	15% ▲	8.1 ▲	7.4	7.1	6.6 ▲
AST (691)	24% ▲	8.1 ▲	7.6 ▲	7.1	6.6 ▲
AT&T GIS (310)	24% ●	7.4 ▼	7.1	6.8	5.7
Austin (91)	44% ▼	7.7	7.7	7.5	6.4
Compaq (1,859)	21% ▲	8.4 ▲	7.9 ▲	7.8 ▲	7.6 ▲
CompuAdd (257)	35% ▼	7.7	7.4	7.0	5.2 ▼
Compudyne (221)	28% ●	7.9	7.3	6.8	5.8
Dell (1,414)	28% ●	8.4 ▲	8.0 ▲	7.8 ▲	7.8 ▲
Digital (319)	23% ▲	8.1 ▲	7.8 ▲	7.8 ▲	6.6 ▲
DTK (258)	32% ●	7.6	7.4	7.0	5.6
Epson (194)	23% ●	7.2 ▼	7.1	6.5 ▼	4.9 ▼
Everex (222)	27% ●	7.6	7.2	6.3 ▼	4.5 ▼
Gateway (2,650)	30% ●	8.5 ▲	7.9 ▲	7.3 ▲	8.0 ▲
Hewlett-Packard (488)	20% ▲	8.3 ▲	7.9 ▲	7.9 ▲	7.2 ▲
Hyundai (81)	33% ●	7.2 ▼	7.1	6.4	3.8 ▼
IBM (2,686)	23% ▲	8.2 ▲	7.7 ▲	7.6 ▲	6.6 ▲
Insight (111)	34% ●	8.4 ▲	8.0 ▲	7.5	7.0 ▲
Leading Edge (290)	27% ●	7.2 ▼	6.7 ▼	6.0 ▼	4.7 ▼
Micron (241)	25% ●	8.9 ▲	8.4 ▲	8.4 ▲	8.7 ▲
MidWest Micro (133)	28% ●	8.2 ▲	7.8	7.5	6.9 ▲
NEC (293)	21% ▲	7.7	7.0	6.9	6.2
Northgate (205)	35% ▼	8.0	7.5	7.6 ▲	5.1 ▼
Packard Bell (1,087)	25% ▲	7.7	7.0 ▼	6.5 ▼	6.3 ▲
PC Brand (143)	38% ▼	7.7	7.2	6.3 ▼	5.8
Samsung (64)	20%	7.6	7.3	6.6	5.5
Tandy (313)	24% ●	6.9 ▼	6.6 ▼	6.2 ▼	4.2 ▼
Tri-Star (76)	38%	8.0	7.7	7.4	6.9 ▲
Unisys (145)	27%	7.3 ▼	6.9	6.6	4.4 ▼
USA Flex (51)	49% ▼	8.0	7.7	7.7	6.4
Wang (63)	35%	6.5 ▼	6.4 ▼	6.4	3.6 ▼
Wyse (72)	25%	7.0 ▼	6.7	6.6	4.1 ▼
ZDS (389)	30%	7.2 ▼	6.5 ▼	6.2 ▼	4.3 ▼
ZEOS (615)	37% ▼	8.4 ▲	7.8 ▲	7.4 ▲	7.6 ▲
AVERAGE	28%	7.8	7.4	7.0	6.0
NOTEBOOK					
Apple (141)	23%	8.1	6.7	7.3	6.9
AST (219)	33%	7.5 ▼	6.7	6.8	6.2
AT&T GIS (66)	21%	8.1	7.0	7.3	7.3 ▲
Austin (54)	50% ▼	7.5	7.2	7.3	6.5
Bondwell (64)	28%	7.3	5.8	5.9 ▼	5.5 ▼
Compaq (791)	24% ▲	8.4 ▲	7.5 ▲	7.8 ▲	7.6 ▲
CompuAdd (96)	39% ▼	6.9 ▼	5.4 ▼	5.8 ▼	4.8 ▼
Dell (246)	33%	7.9	7.3	7.3	6.8
Digital (51)	18%	8.3	7.9	7.7	7.3
Epson (63)	21%	7.9	6.5	7.0	6.1
Gateway (233)	28%	8.2	7.2	7.6 ▲	7.2 ▲
GRiD (54)	26% ●	7.0 ▼	5.7 ▼	6.3	4.2 ▼
Hewlett-Packard (74)	19% ▲	8.6 ▲	7.9	8.2 ▲	8.5 ▲
IBM (714)	28% ●	8.6 ▲	7.7 ▲	7.8 ▲	8.1 ▲
MidWest Micro (56)	45% ▼	7.5	6.3	5.9 ▼	5.9
NEC (202)	22% ▲	8.3 ▲	6.8	7.1	7.2 ▲
Packard Bell (52)	33% ●	7.6	6.4	6.7	6.3
Tandy/Radio Shack (73)	25% ●	8.1	7.8	7.4	5.1 ▼
Texas Instruments (177)	32%	8.2	7.0	7.3	7.5 ▲
Toshiba (889)	19% ▲	8.5 ▲	7.4 ▲	7.5 ▲	8.0 ▲
ZDS (226)	23%	7.3 ▼	6.2 ▼	6.2 ▼	5.1 ▼
ZEOS (103)	30%	8.2	7.0	7.5	6.7
AVERAGE	28%	7.9	6.9	7.1	6.6

ways made Macintosh systems very easy to set up and configure.

IN THE MIDDLE

Acer, Compudyne, DTK, Northgate, Packard Bell, Samsung, Tri-Star, and ZEOS make up our middle group—the C vendors. Compudyne, DTK, and Samsung continue to receive average scores on our three old satisfaction-based measures, as they did on our previous survey. These vendors earn a grade of C by also receiving average scores on our new first-year repair question.

Acer's scores for both the "satisfaction with reliability" and "satisfaction with repair" questions fall to average since our previous survey. The vendor's scores on our other two key measures are average on this survey as well.

In late January, Acer introduced a new product called Acer CPR. Shipping with all systems sold through the retail channel, Acer CPR is a bootable CD that enables users to restore their system to its factory-shipped configuration. Since its introduction, Acer claims a dramatic decrease in the number of replacement hard disks shipped.

Though Packard Bell's "satisfaction with reliability" score is average, its first-year repair score is better than average. On the "satisfaction with repair" and "satisfaction with technical support" questions, however, Packard Bell's scores are worse than average. The company's "future likelihood of buying" score is better than average.

Since Packard Bell opened its new service center in Magna, Utah, one year ago, its telephone technical-support staff has more than tripled. The company also now has forums on both CompuServe and Prodigy.

Though Northgate's score for satisfaction with technical support is still better than average, its scores on our other satisfaction measures have dropped to average from previous surveys. Its score on our "first-year repair" measure is worse than average.

In August 1994, Northgate entered a licensing agreement with HW Electronics, whereby HW can use the Northgate name to manufacture, market, and sell computers. Today, Northgate continues to sell computers through the mail-order

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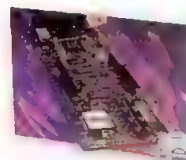
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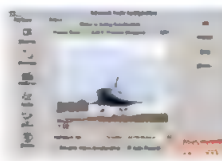
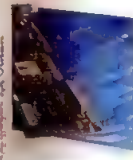
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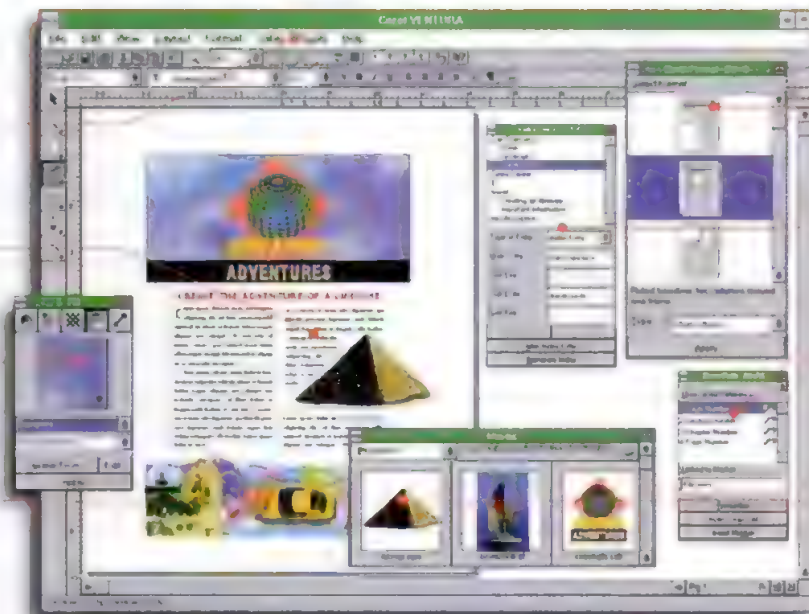
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■ How We Surveyed

In February 1995, we mailed questionnaires to a randomly selected sample of 17,000 *PC Magazine* subscribers. The survey was closed for tabulation March 13, by which time we had received a 50 percent response. The data in this report is based on the 8,435 usable questionnaires (the post office returned 124 questionnaires). Willard & Shullman, a research firm based in Greenwich, Connecticut, tabulated survey results.

Subscribers described up to five desktop and notebook PCs they used over the past two years. Then, on a scale of 1 (lowest) to 10 (highest), respondents rated their satisfaction

with the reliability of each PC and with repair experiences and the technical support they received.

We added a new question to this survey: "How many times did each desktop (notebook) PC need repairs during the first 12 months of use?" The results have been included in the calculation of vendor grades.

STATISTICAL METHODOLOGY

Differences cited herein were evaluated using a standard t-test of means. Such a test considers the scores, the amount of dispersion among scores, and the sample sizes. T-tests tell us whether the difference between two

scores is statistically significant at the 95 percent confidence level. This means that if we conducted this study in exactly the same way 100 times, we could expect the differences reported here to occur at least 95 times.

T-tests may produce anomalous results where two scores that appear close together may be significantly different. One vendor may appear in the average range while another with the same score is better than average. T-tests can also reveal no significant differences between two scores that seem far apart. These results are a function of the objective, evaluative components of a t-test of means. □

Only vendors who received at least 50 responses were included in the final tabulations.

THE FOUR KEY MEASURES: Respondents rated their satisfaction with the reliability of each PC, repair experiences, and tech support on a scale of 1 (lowest) to 10 (highest). They also reported how many times each PC rated needed repairs during the first year of use.

Respondents rated their likelihood of buying a new PC from each vendor. These ratings are not used to calculate Readers' Report Card grades.

Respondents described up to five desktop and five notebook PCs used in the past two years, telling us the manufacturer and chip type of each.

An overall average (mean) was calculated for each measure by adding individual vendor averages and dividing by the number of vendors rated. So each vendor contributes equally to the overall average.

How Readers Rated PC Vendors

▲ Significantly better than average ● = Average ▼ = Significantly worse than average

Vendors (and number of responses)	Units needing repair in the first year	Reliability	Repair	Tech support	Buy again?
DESKTOP					
Compaq (1,859)	21% ▲	8.4 ▲	7.9 ▲	7.8 ▲	7.6 ▲
MidWest Micro (133)	28% ●	8.2 ▲	7.8 ●	7.5 ●	6.9 ▲
AVERAGE	28%		7.4	7.0	6.0

T-tests for means can sometimes produce anomalous results where two scores that appear close together may be significantly different. Here, Compaq's score of 7.9 is significantly better than average, while MidWest Micro's score of 7.8 is average.

channel, although the company is not the major market presence that it was in the late 1980s.

Tri-Star last appeared in our survey a year ago; the company wasn't included in our previous survey because it did not re-

ceive 50 mentions (the minimum required to make statistically significant projections). Tri-Star reappears in this survey, receiving average scores on each of the four key measures.

ZEOS presents a particularly interesting case. Although the vendor continues to be rated by our subscribers as better than average on the three satisfaction measures, it receives a worse-than-average score for first-year repair.

THE DESKTOP D's

AT&T GIS, Austin, CompuAdd, Epson, Everex, Hyundai, Leading Edge, PC Brand, Tandy, Unisys, USA Flex, Wang, Wyse, and Zenith Data Systems (ZDS) each receive a combination of average and worse-than-average scores, for a grade of D. Unlike previous surveys, no desktop vendor was worse than average on all key measures—so no one receives a grade of E.

Austin, CompuAdd, and USA Flex

Our Contributors: RACHEL DERBY TEITLER is a research manager for Ziff-Davis Publishing Co. CAROL VENEZIA is a staff editor of *PC Magazine*.



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Top-notch service and support is no longer a wish-list item for prospective PC buyers—it is a must-have. The five vendors that are the recipients of our

Readers' Choice awards have delivered on their promise of providing not only reliable systems, but also providing support if those systems do break down. All of these vendors achieve significantly better-than-average scores on the four key measures of our Service and Reliability survey: satisfaction with overall reliability, satisfaction with repair experience, satisfaction with technical support, and percentage of units needing repair during the first year of use.

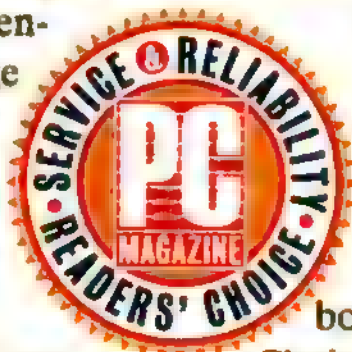
This survey marks an enhanced methodology compared with previous surveys. We now include a question on our Service and Reliability survey that directly measures

the reliability of the desktop and notebook PCs that respondents are rating. This question—"How many times did each PC need repairs during the first 12 months of use?"—is as important as the other three measures that we grade vendors on, which is why it is included in the calculation of Readers' Report Card grades.

The four winners of our Readers' Choice awards in the desktop category are no strangers to the top of the charts: All of them have earned this honor on previous surveys, using our old, three-measure methodology. These vendors earn better-than-average scores on all four key measures of our survey, thereby earning a grade of A on our Readers' Report Card and our Readers' Choice award.

In the notebook arena, the ranks of the elite have thinned considerably since we last surveyed our subscribers. Our Readers' Choice list of notebook vendors now includes only two names, *less than half* the number that achieved this honor in our previous survey.

Veteran Compaq is now joined by Toshiba, which enjoys improved scores for both the "satisfaction with repair experience" and "satisfaction with technical support" questions (relative to our previous survey, "*Making the Grade*," January 10, 1995). Compaq is worthy of special mention in the notebook category: The vendor has maintained Readers' Choice status for six surveys in a row, both under our old methodology in previous surveys and under our new methodology in this survey.



each receive average scores on the old satisfaction-based questions. All would have received grades of C if not for their worse-than-average scores on the first-year repair question.

In contrast, Leading Edge, Tandy, and ZDS receive worse-than-average scores on each of the old survey measures and would have received grades of E if not for their average scores on first-year repair. But these vendors also receive worse-than-average ratings on future likelihood of buying.

In our previous survey, the data reported for AT&T was combined with that of NCR (as AT&T had recently acquired NCR); the result was a grade of B. We continue in this survey to collect data separately for both companies, although the combined scores this time resulted in a grade of D.

AT&T's scores for satisfaction with repair experience and with reliability fall to average and worse than average, respectively. In the past year, AT&T has consolidated its support centers. The company is also concentrating on re-

mote support: All AT&T PCs now come equipped with remote diagnostic capabilities. AT&T also offers BBS and fax-back services to supplement its technical-support lines.

In 1994, Epson enjoyed a marked increase in desktop PC sales; it has added staff to its Epson Connection technical-support line to meet customer demand. In August, Epson plans to add an option to its interactive voice-response system that will allow customers to listen to answers to its five most frequently asked questions.

ZDS has been very active in the area of service in the past year, increasing its telephone technical-support staff by 40 percent. The company has also added remote-diagnostic capabilities to its desktop PCs via CoSession. ZDS now offers telephone support 24 hours a day, 7 days a week—as well as a three-year warranty for its Z-Station desktop systems.

Recently, ZDS reorganized its Technical Assistance Center. This group is now structured into two tiers: If a first-

tier technical-support representative can't answer a customer's question, the call will be forwarded to a more experienced staff member. ZDS has also improved its VAR certification program, placing more stringent requirements on resellers who wish to provide on-site service to ZDS customers.

Reliability by CPU Type

- ▲ = Significantly above average
- = Average
- ▼ = Significantly below average

DESKTOP SYSTEMS

8086/8088/286/386	7.7	▼
Intel 486SX/486DX	8.2	●
Intel 486DX2	8.4	▲
Intel DX4	8.6	▲
AMD 486	8.2	●
Any other 486	8.2	●
Pentium	8.6	▲
AVERAGE	8.3	

NOTEBOOK SYSTEMS

8086/8088/286/386	7.6	▼
Intel 486SX/486DX/486SL	8.3	●
Intel 486DX2	8.4	●
Intel DX4	8.7	▲
Any other 486	8.2	●
AVERAGE	8.2	

TOP-RATED NOTEBOOK VENDORS

The strongest performers on this survey among the notebook vendors are Compaq and Toshiba, both of which earn a grade of A and our Readers' Choice award. Compaq sustains the level of excellence seen in previous studies, receiving better-than-average scores on the old as well as the new survey measures. Both A vendors also receive better-than-average scores for future likelihood of buying.

Toshiba also excels on this survey: Its scores for both satisfaction with repair experience and satisfaction with technical support improve to better than average. On our first-year repair question, Toshiba also receives a better-than-average score.

Toshiba is becoming increasingly active in the on-line services arena. In addition to its presence on CompuServe, the vendor now has its own home page on the World-Wide Web (through Toshiba America Inc.). In the future, Toshiba plans to bundle Internet access software with select portables, as well as offer an Internet link to its FTP server so users can download drivers, utilities, and tech notes.

THE B VENDORS

Notebook vendors earning a grade of B on this survey are Gateway, Hewlett-Packard, IBM, and NEC. All notebook vendors that receive an A or a B on our Readers' Report Card also enjoy better-than-average scores for future likelihood of buying.

IBM continues to receive better-than-average scores on the three satisfaction-related survey questions. But its average score on our new first-year repair question prevents the vendor from receiving a grade of A this time. NEC earns a better-than-average "satisfaction with reliability" score and also now enjoys a better-than-average score for first-year repair.

Both Gateway and HP fail to maintain the better-than-average scores that they enjoyed on our previous survey for the three satisfaction-related survey questions. HP's "satisfaction with repair" score is now average, while Gateway's average ratings now include both satisfaction with reliability and satisfaction with repair. HP earns a better-than-average score for first-year repair, while Gateway's score on this measure was average.

Vendor Grades: Past and Present

	July 1995*	January 10, 1995	July 1994	January 11, 1994	July 1993	February 9, 1993
DESKTOP VENDORS						
Acer	C	B	C	D	D	E
ALR	B	D	C	E	C	D
Apple	B	B	B	B	C	C
AST	B	C	C	B	B	A
AT&T GIS/NCR**	D	B	E/C	E/C	E/C	E/D
Austin	D	C	B	B	A	C
Compaq	A	A	A	B	A	B
CompuAdd	D	B	C	C	A	B
Compudyne	C	C	C	C	C	N/A
Dell	B	A	A	A	A	A
Digital	A	A	A	B	B	A
DTK	C	C	C	D	C	C
Epson	D	D	E	D	C	C
Everex	D	D	D	C	C	B
Gateway	B	A	A	A	A	A
Hewlett-Packard	A	A	A	A	B	B
Hyundai	D	E	E	E	D	E
IBM	A	A	A	B	B	B
Insight	B	B	B	N/A	N/A	N/A
Leading Edge	D	D	E	E	E	D
Micron	B	A	A	B	N/A	N/A
MidWest Micro	B	C	N/A	N/A	N/A	N/A
NEC	B	C	C	D	B	B
Northgate	C	A	A	B	A	A
Packard Bell	C	E	E	E	E	D
PC Brand	D	C	C	C	C	C
Samsung	C	C	D	C	C	N/A
Swan	N/A	B	B	A	A	A
Tandy	D	E	E	E	E	E†
Tri-Star	C	N/A	A	C	B	C
Unisys	D	D	C	C	D	C
USA Flex	D	N/A	N/A	N/A	N/A	N/A
Wang	D	D	D	D	D	D
Wyse	D	E	E	D	E	E
ZDS	D	E	E	E	E	E
ZEOS	C	A	A	A	A	A
NOTEBOOK VENDORS						
Acer	N/A	C	B	N/A	N/A	N/A
Apple	C	A	A	A	B	C
AST	D	D	D	D	B	C
AT&T GIS/NCR**	C	B	N/A	N/A	N/A	N/A
Austin	D	N/A	N/A	N/A	N/A	N/A
Bondwell	D	C	C	D	D	E
Compaq	A	A	A	A	A	A
CompuAdd	E	D	E	C	C	B
Compudyne	N/A	D	D	E	E	N/A
Dell	C	D	C	B	A	B
Digital	C	C	B	B	N/A	N/A
Epson	C	C	C	C	D	C
Everex	N/A	D	C	C	C	B
Gateway	B	A	B	A	C	N/A
GRiD	D	D	D	C	C	C†
Hewlett-Packard	B	A	B	N/A	N/A	N/A
IBM	B	A	A	B	A	B
MidWest Micro	D	N/A	N/A	N/A	N/A	N/A
NEC	B	B	B	D	D	D
Packard Bell	C	N/A	N/A	N/A	D	N/A
Tandy	C	D	C	C	D	C†
Texas Instruments	C	A	A	C	C	C
Toshiba	A	B	B	B	A	B
ZDS	D	E	E	E	E	E
ZEOS	C	D	B	C	A	A

N/A Not applicable: The vendor did not receive the minimum 50 responses needed for inclusion in this survey

* Grades are based on a methodology different from previous surveys

** AT&T GIS now includes NCR. Both companies appeared separately in previous surveys

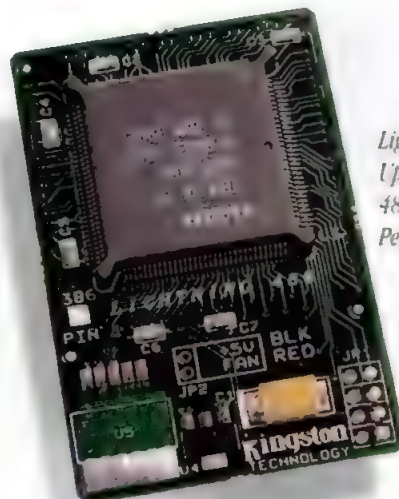
† GRiD Systems Corp. and Tandy appeared as one entity in this survey

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Application	Native	With TurboChip	Performance Increase
Microsoft Excel *	38 Seconds	17 Seconds	123%
Microsoft Word **	50 Seconds	30 Seconds	66%
Landmark Speed v.2.0	112MHz	332MHz	196%

Lightning 486 Increases Your Performance Over 550%
IBM PS/2 Model 70

Application	Native	With Lightning 486	Performance Increase
Microsoft Excel *	2 Min., 37 Sec.	41 Seconds	282%
Microsoft Word **	2 Min., 26 Sec.	59 Seconds	147%
Landmark Speed v.2.0	23MHz	153MHz	565%

* Kingston conducted a test on an IBM Microsoft Excel for Windows 5.0 spreadsheet in which a numerical equation was changed in a cell. Once the equation was altered, Excel was instructed to recalculate the entire spreadsheet by using the "Fill Down" command. Measured in amount of time, lower is better.

** Kingston conducted a test on a 638KB Microsoft Word for Windows 6.0 document in which the word "the" was replaced with "Kingston Technology". Once the word was changed, Word was instructed to edit the document by using the "Replace All" command. Measured in amount of time, lower is better.

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▲ = Significantly better than average ● = Average ▼ = Significantly worse than average

	Units needing repair in the past 6 months	Number of days to repair	Minutes to connect	Length of call (minutes)	Hours for response
DESKTOP VENDORS					
Acer	15% ●	4.6 ●	11.5 ●	14.0 ●	10.0 ●
ALR	14% ●	4.8 ●	8.7 ●	8.3 ●	3.5 ●
Apple	10% ▲	3.7 ●	8.8 ●	10.7 ●	5.0 ●
AST	14% ●	4.1 ●	10.9 ▼	13.3 ▼	6.4 ●
AT&T GIS	16% ●	4.0 ●	6.3 ▲	8.3 ●	7.0 ●
Austin	14% ●	4.3 ●	6.0 ▲	9.3 ●	6.6 ●
Compaq	13% ▲	3.9 ▲	9.6 ●	12.2 ▼	6.0 ●
CompuAdd	13% ●	4.9 ●	6.7 ▲	9.0 ●	2.1 ▲
Compudyne	14% ●	4.2 ●	7.7 ●	10.6 ●	4.0 ●
Dell	15% ●	3.1 ▲	10.3 ▼	13.3 ▼	7.7 ●
Digital	10% ▲	3.9 ●	7.4 ●	9.0 ●	6.3 ●
DTK	19% ●	3.1 ▲	4.9 ▲	5.9 ▲	1.9 ▲
Epson	18% ●	3.7 ●	7.8 ●	9.2 ●	6.8 ●
Everex	13% ●	4.7 ●	8.0 ●	11.3 ●	7.2 ●
Gateway	15% ●	5.5 ▼	14.7 ▼	18.4 ▼	10.3 ▼
Hewlett-Packard	13% ●	3.0 ▲	5.5 ▲	8.3 ▲	3.8 ▲
Hyundai	14% ●	4.2 ●	5.2 ▲	7.0 ●	7.3 ●
IBM	14% ●	3.7 ▲	7.5 ▲	9.8 ●	7.0 ●
Insight	16% ●	5.2 ●	13.8 ▼	17.9 ▼	14.5 ●
Leading Edge	14% ●	6.0 ●	9.2 ●	11.1 ●	4.7 ●
Micron	18% ●	4.5 ●	10.2 ●	13.2 ▼	7.9 ●
Midwest Micro	14% ●	8.2 ●	10.6 ●	16.4 ▼	8.8 ●
NEC	12% ●	4.7 ●	10.5 ●	11.6 ●	6.0 ●
Northgate	12% ●	5.1 ●	7.1 ●	8.4 ●	4.8 ●
Packard Bell	13% ●	6.5 ▼	15.7 ▼	16.6 ▼	8.9 ●
PC Brand	18% ●	4.9 ●	10.1 ●	11.3 ●	8.7 ●
Samsung	11% ●	5.9 ●	6.9 ●	7.0 ●	15.0 ●
Tandy	13% ●	6.8 ▼	5.5 ▲	8.5 ●	4.1 ●
Tri-Star	14% ●	4.1 ●	10.1 ●	7.8 ▲	11.9 ●
Unisys	19% ●	3.8 ●	2.3 ▲	3.3 ▲	5.0 ●
USA Flex	22% ●	5.9 ●	13.9 ●	9.3 ●	9.4 ●
Wang	19% ●	5.2 ●	8.4 ●	8.9 ●	8.3 ●
Wyse	17% ●	2.8 ▲	2.5 ▲	5.4 ▲	1.7 ▲
ZDS	17% ●	5.4 ●	7.8 ●	9.4 ●	7.5 ●
ZEOS	16% ●	6.3 ▼	14.1 ▼	16.6 ▼	17.2 ▼
AVERAGE	15%	4.6	8.7	10.6	7.2
NOTEBOOK VENDORS					
Apple	17% ●	6.8 ●	9.4 ●	12.4 ●	2.9 ●
AST	21% ●	7.9 ●	10.8 ●	13.3 ●	4.2 ●
AT&T GIS	11% ●	5.3 ●	4.5 ▲	10.1 ●	2.4 ●
Austin	37% ▼	4.5 ▲	5.4 ▲	9.6 ●	3.7 ●
Bondwell	19% ●	9.8 ●	9.8 ●	10.8 ●	10.4 ●
Compaq	15% ●	8.2 ▲	12.2 ▼	13.7 ▼	4.9 ●
CompuAdd	26% ●	11.5 ▼	5.6 ▲	6.6 ▲	0.4 ▲
Dell	19% ●	8.2 ●	10.7 ●	14.4 ●	4.7 ●
Digital	16% ●	6.7 ●	3.4 ▲	6.3 ▲	1.8 ▲
Epson	11% ●	5.9 ●	11.4 ●	11.6 ●	3.2 ●
Gateway	17% ●	7.6 ●	9.9 ●	14.3 ▼	7.0 ●
GRiD	13% ●	12.8 ●	6.5 ●	8.0 ●	0.8 ▲
Hewlett-Packard	14% ●	6.5 ●	5.6 ▲	8.5 ●	2.3 ●
IBM	18% ●	5.4 ▲	7.8 ●	11.8 ●	5.0 ●
MidWest Micro	29% ●	9.5 ●	13.2 ▼	17.0 ▼	14.9 ●
NEC	13% ●	6.7 ●	8.3 ●	9.6 ●	2.1 ▲
Packard Bell	19% ●	14.3 ▼	10.9 ●	12.3 ●	1.5 ▲
Tandy	10% ▲	6.2 ●	2.5 ▲	3.4 ▲	No data
Texas Instruments	17% ●	5.4 ▲	15.6 ▼	15.3 ●	12.9 ●
Toshiba	12% ▲	7.8 ●	8.4 ●	10.0 ●	3.9 ●
ZDS	15% ●	7.8 ●	6.7 ●	8.2 ●	11.3 ●
ZEOS	15% ●	7.5 ●	13.2 ▼	13.5 ●	18.3 ▼
AVERAGE	17%	7.7	8.7	10.9	5.4

Gateway, however, has not been idle in the notebook arena since our previous survey. Late last year, the company phased out its Handbook line and introduced its new Liberty subnotebooks. Gateway also now has a toll-free technical-support line dedicated to notebooks.

C-LEVEL PORTABLES

For notebooks, nine vendors receive C's: Apple, AT&T GIS, Dell, Digital, Epson, Packard Bell, Tandy, Texas Instruments, and ZEOS. Each receives average scores on the four key measures.

Regarding the satisfaction-based questions, only Digital and Epson received consistently average scores on previous surveys. Apple, AT&T, and TI all performed better on these measures in the past, while Dell, Tandy, and ZEOS all enjoy better ratings on the old key measures in this survey.

Apple's warranty and support programs for its portables have not changed since our previous survey. But the company has made a major thrust into the on-line community not only with forums on CompuServe and the Internet, but also with eWorld—its own on-line service, introduced in June 1994. eWorld also serves as a point of registration and source of product information and support for Macintosh users.

In September 1994, TI began bundling PC Doctor, a remote diagnostics package, with all TravelMate 4000M notebooks. PC Doctor also comes with TI's new Pentium-powered TravelMate 5000 notebook line, which just started shipping this past May.

In October 1994, TI expanded its telephone support to 24 hours, 7 days; it has also significantly increased the number of people answering the phones. TI also continues to expand its on-line presence. You can now find TI on the World-Wide Web, in addition to America Online and CompuServe, as the company established its own home page on May 1 of this year.

NOTEBOOK D's & E's

Vendors earning a D include AST, Austin, Bondwell, GRiD, MidWest

Micro, and ZDS. Austin and MidWest Micro are both new to our notebook ratings. Each of the remaining vendors have historically earned D's or E's, and the addition of our first-year repair survey measure does little to change this fact. CompuAdd is the only vendor here to earn an E, with worse-than-average scores on all four measures.

Last summer, ZDS increased its technical-support hours and staff and started a three-year warranty program with its (then) new Z-NoteFlex notebook. The Z-NoteFlex also comes bundled with CoSession remote diagnostic software, so support technicians can dial in to a customer's system to diagnose problems.

MUZAK, PLEASE: HOW LONG ON HOLD?

In addition to our new first-year repair measure, this survey brings with it new questions that dig deeper into the issues of repairs and technical support. These questions provide information on the average number of days it took vendors to repair systems, the length of time that the respondents had to wait to be connected to a telephone technical-support rep, the length of time that the actual call lasted, and (if the vendor used a call-back technical-support system) how many hours it took for someone to call back.

The data reveals some interesting information about desktop ven-

dors in particular. DTK, Hewlett-Packard, and Wyse are the only desktop vendors to enjoy scores on our three technical-support questions that are significantly better than average (see "Telephone Technical Support").

Gateway and ZEOS respondents were highly satisfied overall with these vendors' technical support, as both vendors receive better-than-average scores on this measure. But when we drilled down through our new questions, we found that both vendors' scores on all three measures (connect time, call length, and response time) are significantly worse than the average.

WHAT WILL THE FUTURE BRING?

As innovation continues to shape the face of the computer market, buyers should expect to get more PC for their dollar than ever before. Just as important as the speediest processor or the biggest hard disk, however, is a reliable system backed by quality service and support. This bodes well for the buyer, as the best vendors will aim to deliver. □

*Callers to Gateway,
Packard Bell, and ZEOS
spent over 14 minutes on
hold—50 percent longer
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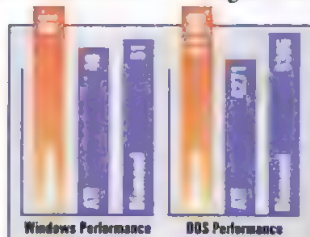
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CIRCLE 124 ON READER SERVICE CARD

Support & Satisfaction

The quality with which software companies support their products is a major concern for *PC Magazine* readers. Tune in to our third annual reader survey and see how your favorite products—and their support services—fared.

By Sarah L. Roberts



Call it the Year of the Merger, the Year of Consolidation, or what you will, the past 12 months have been one of the most eventful periods in the history of the PC software industry. Publishers needing instant product lines (like WordPerfect/Novell) acquired properties from here and there, former competitors (like Adobe and Aldus) became partners, and companies that seemed like the last of the independents (like Intuit) cut deals with the big guys (like Microsoft).

In the wake of all this activity, with individual companies now selling—and supporting—a much greater diversity of products, how will buyers and users of software fare? This consolidation could solve some of the software industry's problems as policies (especially support policies) become more uniform, but it certainly won't solve all of them. In fact, as companies become larger and more unwieldy, new problems may be created—you may have to pay more or at least wait longer for your technical support questions to be answered. And now that the lines in the campaign to capture market share are drawn more clearly than ever, consumers may be wondering what to expect from these huge conglomerates when the need for support does arise.

We questioned readers about the support that they're getting for their word processors, spreadsheets, graphics applications, databases, operating systems and environments, and applications suites—and then asked them how satisfied they are with that support. We got some interesting answers, which we

will discuss in more detail later.

As the software industry evolves and changes, so does the kind of product support users are getting. In these days of mergers, acquisitions, consolidations, and cutbacks, companies are being forced to think about what types of support make the most sense—particularly from an economic standpoint.

For example, some companies are experimenting with outsourcing their support to third-party providers like Corpo-

rate Software and Software Support. These companies can relieve software publishers of the burden and expense of building technical-support staffs and at the same time provide users with 24-hour-a-day, 7-day-a-week support. "I predict that by the year 2000, none of the software publishers will be doing their own support—all support will be outsourced," says Joseph A. Jacoboni, president and CEO of Software Support. "It's already happening quickly."

HOW READERS RATED THE SOFTWARE

	Overall satisfaction	Likelihood of recommending the product
WORD PROCESSORS		
Ami Pro for OS/2	7.9 ▲	7.8 ▲
Ami Pro for Windows	8.7 ▲	8.7 ▲
Microsoft Word for DOS	8.3 ▲	7.8 ▼
Microsoft Word for Windows	8.7 ▲	9.0 ▲
WordPerfect for DOS	8.6 ▲	8.3 ▲
WordPerfect for Windows	8.5 ▲	8.7 ▲
AVERAGE	8.5	8.4
SPREADSHEETS		
Lotus 1-2-3 for DOS	8.1 ▼	7.5 ▼
Lotus 1-2-3 for OS/2	7.9 ▲	7.7 ▲
Lotus 1-2-3 for Windows	8.5 ▲	8.4 ▲
Microsoft Excel	8.8 ▲	9.0 ▲
Quattro Pro for DOS	8.3 ▲	7.7 ▼
Quattro Pro for Windows	8.6 ▲	8.5 ▲
AVERAGE	8.4	8.1
GRAPHICS APPLICATIONS		
Adobe PageMaker	8.1 ▲	7.9 ▲
Adobe Photoshop	8.5 ▲	8.4 ▲
Corel Ventura	7.9 ▲	7.9 ▲
CorelDRAW	8.3 ▲	8.3 ▲
Freehand Graphics for DOS	7.7 ▲	6.9 ▼
Freehand Graphics for Windows	7.9 ▲	7.8 ▲
Harvard Graphics for DOS	7.5 ▼	6.8 ▼
Harvard Graphics for Windows	8.0 ▲	7.7 ▲
Micrografx Designer	7.8 ▲	7.5 ▲
Microsoft PowerPoint	7.9 ▲	8.1 ▼
AVERAGE	8.0	7.7

▲ = Significantly better than average ● = Average
▼ = Significantly worse than average

THOSE WERE THE DAYS

No matter what kind of support model a company chooses to follow, the days of free, unlimited technical support over the telephone appear to be drawing rapidly to a close. More and more, software vendors are implementing policies of restricted or pay-as-you-go phone support and prepaid support contracts.

Nevertheless, even as publishers cut back on the traditional, more-or-less real-time medium of phone-based user assistance, they are experimenting with other, more cost-effective media. In perhaps the trendiest example, using the Internet—especially the World-Wide Web—as a support vehicle seems to be really taking off this year.

As we were preparing this story, several software vendors, including Lotus Development Corp., announced new World-Wide Web sites that will help provide technical support for their products. "We want our customers to have easier access to support, and we want to make our customers more self-sufficient," says Michael Hayes, director of service and product marketing for Lotus. "Except for the connection time, the World-Wide Web is a way of essen-

tially providing free support."

These sites provide users with massive amounts of content—ranging from answers to frequently asked questions (FAQs) to more information on the product and its history to background on the company.

Microsoft seems to be leading the charge as far as exploiting the Internet for technical support is concerned. You can access the Microsoft Knowledge Base, the Microsoft Software Library, and other resources via Microsoft's World-Wide Web, gopher, or FTP sites.

Other companies are close on Microsoft's heels, though: Adobe Systems, Alpha Software Corp., Corel Corp., Lotus, and others all have Web sites, many of which offer FAQs and other pertinent information.

In yet another service-oriented on-line trend, software companies are maximizing and publicizing what they offer through their BBSs. In addition to the traditional channels, companies like Symantec are

providing users with new product features on-line instead of making users wait for major upgrades. There's the other side, of course (harkening back to the problems Quicken and other tax software vendors had earlier this year): Vendors are also using these venues to make bug fixes available. Posting patches on BBSs is nothing new, but software companies seem to be promoting it vigorously.

Though not every software user has the resources to take advantage of such on-line help services, more do than ever before. They are the clear winners in today's software market.

HOW WE SURVEYED

In this, our third annual investigation of software support and satisfaction, we sent out a survey to 17,000 randomly selected *PC Magazine* subscribers. Our report is based on 8,435 responses. The results were tabulated by the research firm of Willard & Shullman, just as they were for the Service and Reliability report in this issue. We asked our survey participants to go into considerable depth when rating technical support in ten different ways so we could get a full picture of companies' support policies and the quality of the actual support delivered. Readers rated their satisfaction in the following areas on a scale of 1 to 10 where 1 was "not at all satisfied" and 10 was "very satisfied": overall technical support, written documentation, vendor support via BBS, built-in help functions, tutorials, and replacement of defective disks. (For more details on our survey methodology, see "How We Surveyed" in our story "Service and Reliability: Are You Getting What You Need?")

This year, we also added a new set of questions aimed at getting a better understanding of our readers' technical-support experiences—particularly how timely such support really is.

The new questions asked readers about the number of times they'd had a problem that required a technical-support call, how many calls they had to make be-

fore they actually were helped, how many minutes they had to wait before being connected to a technical-support person, and, if the question was answered, how long the call was. In a related vein, we also asked about call-back technical support, since many vendors are implementing that system: We wanted to know how many hours it took for companies to respond to user calls.

Not all of our readers responded to this series of questions, but those who did gave us a good sense of what their tech-support experiences were like. Information from these questions is presented in the Telephone Technical Support charts, which are new to this year's story.

This has been a tumultuous year in the software industry, and there's certain to be more excitement and change to come. As the results of Merger Mania play out over the next 12 months, we can only hope that the high drama in the industry is matched by a high level of customer support.

Word Processors

All in all, the word processor category has remained quite stable since we last conducted our survey of support and satisfaction. The biggest trend seems to be the continuation of Windows-based products truly taking the lead, while DOS-based products fade in users' consciousness. In a striking example, WordPerfect for DOS—traditionally a leader—received average scores for both overall satisfaction and likelihood of being recommended, instead of the better-than-average scores it received last year. (Overall technical support is where WordPerfect for DOS redeemed itself with a better-than-average score, just as it did last year.)

As we delve deeper, the dominance of Windows packages becomes even clearer. For Ami Pro for Windows, three seems to be a charm. Once again, this package received better-than-average scores for overall satisfaction, satisfaction with tech-

*Companies like
Symantec are providing
users with new product
features instead of
making users wait for
major upgrades.*

HOW READERS RATED THE SOFTWARE

	Overall satisfaction	Likelihood of recommending the product
DATABASES		
Alpha Four	7.9	7.7
Clipper	8.4	7.5
dBASE for DOS	7.4	6.4
dBASE for Windows	8.2	8.0
Lotus Approach	7.8	7.8
Microsoft Access	8.2	8.5
Microsoft FoxPro for DOS	8.3	7.9
Microsoft FoxPro for Windows	8.1	8.0
Oracle	7.8	7.2
Paradox for DOS	7.6	7.0
Paradox for Windows	7.8	7.5
Q&A	7.8	6.9
RBASE	7.3	6.4
AVERAGE	7.9	7.4
APPLICATION SUITES		
Lotus SmartSuite for Windows	8.2	8.1
Microsoft Office	8.4	8.6
Microsoft Works	8.2	8.1
PerfectOffice	8.4	8.4
AVERAGE	8.3	8.3
OPERATING SYSTEMS AND ENVIRONMENTS		
Microsoft Windows	7.8	8.4
Microsoft Windows NT	8.4	8.6
MS-DOS	8.4	8.3
OS/2	8.8	8.9
PC DOS	8.2	7.9
AVERAGE	8.3	8.4

▲ = Significantly better than average ● = Average
▼ = Significantly worse than average

nical support, and likelihood of being recommended—the only word processor to achieve this distinction.

When asked to rate how likely they would be to recommend a product for purchase, subscribers gave Ami Pro for Windows, Microsoft Word for Windows, and WordPerfect for Windows their votes of confidence with better-than-average scores; once again, the Windows products stood out. (Microsoft Word for DOS was the only product to receive a worse-than-average score in this category.)

And all the Windows word processors—Ami Pro for Windows, Microsoft Word for Windows, and WordPerfect for Windows—were strong in on-line help, where each received a better-than-average score.

Microsoft Word for Windows, which accounts for almost half of the word processing packages rated by subscribers, received a better-than-average score for overall satisfaction but didn't fare as well when judged for overall technical support (though its score was still average).

This year, for the first time in our survey's history, we did not include industry pioneer WordStar. In a first of another kind, Ami Pro for OS/2 received enough mentions to be included in our survey results. (Of the responses, however, Ami Pro for OS/2 accounts for only 1 percent.) In the light of Ami Pro for Windows' success, it will be interesting to track the impact IBM's OS/2 Warp will have on the future success of Ami Pro for OS/2.

Spreadsheets

The same pattern that emerged for word processors seems to hold true for spreadsheets as well—Windows products are doing extremely well as DOS products continue to fade. This trend was particularly clear in this year's scores for overall technical support. The three Windows products (Lotus 1-2-3 for Windows, Microsoft Excel, and Quattro Pro for Windows) all received better-than-average scores for overall technical support; last year, none of the surveyed products did. Quattro Pro for Windows received better-than-average

scores in both documentation and BBS support.

The three Windows products also scored better than average for both overall satisfaction and likelihood of being recommended—a clean sweep. Our subscribers' assessment of Quattro Pro for DOS has changed quite a bit, however. It went from better than average for overall satisfaction and likelihood of being recommended last year to average for overall satisfaction and worse than average for likelihood of being recommended this year.

The landscape has also changed in terms of the proportion of the respondent user base each product commands. In last year's survey, competition between Lotus and Microsoft was fierce, but it has opened up considerably this time around: Microsoft Excel accounts for nearly half the packages (49 percent, up from 38 percent last year); Lotus 1-2-3 for Windows represents just over a quarter (28 percent, down from 34 percent last year). Of the big three, Borland has the smallest share, with just 18 percent.

On the other hand, those who claim Quattro Pro—especially Quattro Pro for Windows—as their spreadsheet seem to be quite satisfied.

Graphics Applications

Although the graphics applications category remains as eclectic as ever—a mix of presentation, drawing and painting, and desktop publishing packages—the population has changed a bit. One familiar oldie, Micrografx Draw, was dropped, and newcomer Adobe Photoshop took its place. Photoshop and CorelDRAW were the only two packages to receive better-than-average scores in both overall satisfaction and likelihood of being recommended.

Microsoft PowerPoint had perhaps the oddest compilation of scores among graphics packages in this year's survey. It scored significantly better than average for both likelihood of being recommended and overall technical support. It was the only graphics package to receive a better-than-average score for overall

HOW READERS RATED TECHNICAL SUPPORT

	Overall support	Documentation	BBS support	Built-in help	Tutorials	Replacement of defective disks
WORD PROCESSORS						
Ami Pro for OS/2	7.3 ●	7.3 ●	6.4 ●	7.2 ●	7.5 ●	9.2 ●
Ami Pro for Windows	8.5 ▲	7.9 ●	7.8 ●	8.0 ▲	7.7 ●	9.2 ●
Microsoft Word for DOS	8.2 ●	7.8 ●	8.0 ●	7.6 ●	7.4 ●	9.5 ▲
Microsoft Word for Windows	8.0 ●	7.6 ●	7.9 ●	8.0 ▲	7.7 ●	8.8 ●
WordPerfect for DOS	8.6 ▲	7.9 ▲	8.2 ▲	7.6 ●	7.5 ●	9.0 ●
WordPerfect for Windows	8.4 ●	7.8 ●	7.9 ●	7.9 ▲	7.7 ●	8.6 ▼
AVERAGE	8.2	7.7	7.7	7.7	7.6	9.1
SPREADSHEETS						
Lotus 1-2-3 for DOS	7.5 ●	7.5 ●	6.9 ●	7.0 ▼	7.1 ●	8.1 ●
Lotus 1-2-3 for OS/2	6.8 ●	6.9 ●	7.2 ●	7.3 ●	6.6 ●	7.2 ●
Lotus 1-2-3 for Windows	8.1 ▲	7.6 ●	7.7 ●	7.6 ●	7.6 ▲	8.5 ●
Microsoft Excel	8.1 ▲	7.6 ●	7.9 ▲	8.0 ▲	7.6 ▲	8.8 ●
Quattro Pro for DOS	7.7 ●	7.9 ▲	7.1 ●	7.0 ▼	6.9 ●	8.8 ●
Quattro Pro for Windows	8.2 ▲	7.8 ▲	8.0 ▲	7.9 ▲	7.8 ▲	8.9 ●
AVERAGE	7.7	7.6	7.5	7.5	7.3	8.4
GRAPHICS APPLICATIONS						
Adobe PageMaker	7.6 ●	7.6 ●	7.3 ●	7.2 ●	7.4 ●	7.2 ●
Adobe Photoshop	8.0 ●	7.6 ●	7.6 ●	7.4 ●	7.4 ●	9.2 ▲
Corel Ventura	7.1 ●	7.8 ●	6.8 ●	7.5 ●	6.8 ●	8.5 ●
CorelDRAW	7.6 ●	7.6 ●	7.0 ●	7.2 ●	7.1 ●	8.5 ●
Freelance Graphics for DOS	7.4 ●	7.3 ●	6.5 ●	6.6 ▼	6.3 ▼	8.2 ●
Freelance Graphics for Windows	7.8 ●	7.4 ●	7.4 ●	7.2 ●	7.4 ▲	8.5 ●
Harvard Graphics for DOS	7.3 ●	7.2 ▼	6.5 ●	6.6 ▼	6.7 ▼	7.4 ●
Harvard Graphics for Windows	7.8 ●	7.5 ●	7.4 ●	7.2 ●	7.4 ●	7.6 ●
Micrografx Designer	7.5 ●	7.3 ●	6.9 ●	6.8 ●	6.9 ●	8.0 ●
Microsoft PowerPoint	7.9 ▲	7.4 ●	7.8 ▲	7.7 ▲	7.4 ▲	8.8 ▲
AVERAGE	7.6	7.5	7.1	7.1	7.1	8.1

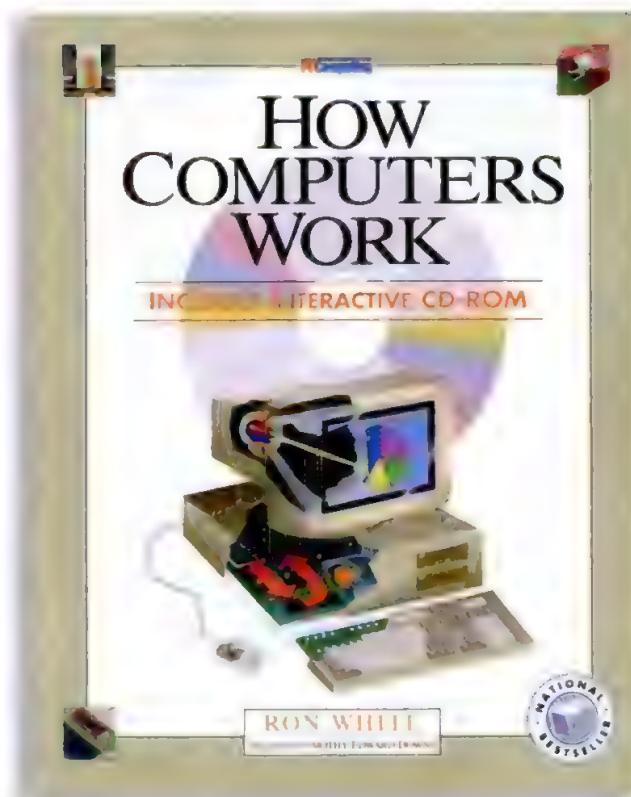
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Support & Satisfaction

SOFTWARE VENDORS: SUPPORT OFFERINGS

■ YES ■ NO								
Company	Products	Toll-free support number	Technical-support numbers (phone, fax, fax-back)	Technical-support hours (eastern time)	Free technical support	900 number (cost per minute)	Public BBS (service forum or command)	Private BBS number
Adobe Systems Inc.	Adobe Illustrator, Adobe Photoshop, Adobe PageMaker, Adobe Persuasion	800-628-2320	Adobe Illustrator, 206-628-3954; Adobe Photoshop, 206-628-3956; Adobe PageMaker, 206-628-4531; Adobe Persuasion, 206-628-4533; fax-back, 206-628-5737	9:00-8:00 M-F	90 days from first call	Adobe Illustrator, 900-555-4558; Adobe Photoshop, 900-555-7468; Adobe PageMaker and Persuasion, 900-555-2200 (\$2)	AOL (ALDUS), CompuServe (GO ADOBEAPP)	206-623-6984
Alpha Software Corp.	Alpha Four	Available with support plan	617-272-3680; fax, 617-273-1507; fax-back, 800-368-8872	9:00-6:00 M-F	Installation and configuration	900-555-2574 (\$2)	AOL (ALPHATECH), CompuServe (GO PCVEN), Prodigy	617-229-2915
Borland International Inc.	dBASE for DOS, dBASE for Windows, Paradox for DOS, Paradox for Windows	Available with support plan	dBASE for DOS, 408-431-9060; dBASE for Windows, 408-461-9110; Paradox for DOS, 408-466-9155; Paradox for Windows, 408-461-9166; fax-back, 800-822-4269	9:00-8:00 M-F	Installation and configuration	dBASE for DOS, 900-555-1003; dBASE for Windows, 900-555-1009; Paradox for DOS, 900-555-1000; Paradox for Windows, 900-555-1006 (\$2)	BIX (JOIN BORLAND), CompuServe (GO BORLAND), GEnie (BORLAND)	408-431-5096
Claris Corp.	ClarisWorks for Windows	Available with support plan	408-727-9054, 408-727-9004; fax-back, 800-800-8954, 408-987-3900	9:00-9:00 M-Th, 9:00-5:00 F	90 days from first call	900-230-3000 (\$2)	AOL (CLARIS), CompuServe (GO CLARIS)	408-987-7421
Computer Associates	Clipper	Available with support plan	310-348-4400; fax, 516-342-6861	9:00-8:00 M-F	3 months	None	CompuServe (GO CAI)	516-434-1753
Corel Corp.	CorelDRAW	800-818-1848	Fax-back, 613-728-0826 ext. 3080, document #2000	4:00 A.M.-8:00 P.M. M-F	Two calls	900-896-8880 (\$2)	CompuServe (GO COREL)	613-728-4752
DataEase International	DataEase	None	203-374-8000, 203-374-2825; fax, 203-365-2317; fax-back, 203-265-2311	9:00-6:00 M-F	Limited number of problems, unlimited calls until problems are solved	None	CompuServe (GO DATAEASE)	None
IBM Corp.	OS/2, PC DOS	800-992-4777	fax, 800-426-6063; fax-back, 800-442-6329	8:00-8:00 M-F	60 days from first call	None	CompuServe (GO OS/2SUP), Prodigy (JUMP OS/2CLUB)	800-547-1283 (OS/2)
Lotus Development Corp.	Ami Pro for DOS, Ami Pro for Windows, Freelance Graphics for DOS, Freelance Graphics for OS/2, Freelance Graphics for Windows, Lotus Approach, Lotus 1-2-3 for DOS, Lotus 1-2-3 for Windows	Available with support plan	800-553-4270; fax-back, 800-346-3508	8:00-8:00 M-F	90 days	900-555-6887 (\$35 per incident)	CompuServe (GO LOTUS)	404-395-7707 (word processing), 617-693-7000 (desktop)
Micrografix Inc.	Micrografix Designer	None	214-234-2694; fax, 214-994-6476	8:00-6:00 M-F	30 days	900-847-8477 (\$2)	AOL (MCX), CompuServe (GO MICROGRAFX)	None
Micronix Inc.	R BASE	Available with support plan	206-649-9551; fax, 206-746-9350	10:00-7:00 M-F	Until 1 year after release of new version	900-454-9730 (\$2)	CompuServe (GO MICRORIM)	206-649-9836
Microsoft Corp.	Microsoft Access, Microsoft FoxPro for DOS, Microsoft Excel, Microsoft FoxPro for Windows, Microsoft Office, Microsoft PowerPoint, Microsoft Windows, Microsoft Windows NT, Microsoft Works, MS-DOS	Available with support plan	Microsoft Access, 206-635-7050; Microsoft Excel, 206-635-7070; Microsoft FoxPro, 206-635-7191; Microsoft Office, 206-635-7056; Microsoft PowerPoint, 206-635-7145; Microsoft Windows, 206-637-7098; Microsoft Works, 206-635-7130; MS-DOS, 206-648-5104	9:00-9:00 M-F	Desktop apps, unlimited; OSs, 90 days	Available with support plan	CompuServe (GO MICROSOFT)	None
Novell Inc.	PerfectOffice, Quattro Pro for DOS, Quattro Pro for Windows, WordPerfect for DOS, WordPerfect for Windows	Available with support plan	Fax, 801-222-5077	8:30-7:30 M-F	180 days or limited number of problems	Available with support plan	CompuServe (GO NOVELL)	801-221-5197, 801-222-9111, 801-225-4414, 801-225-4444
Oracle Corp.	Oracle	Available with support plan	415-506-1500	8:00-9:00 M-F	30 days	None	CompuServe (GO ORACLE)	407-888-1234
Quark Inc.	QuarkXPress	Available with support plan	303-894-8822; fax, 303-894-3398	9:00-8:00 M-F	90 days	None	AOL (QUARK), CompuServe (GO QUARK)	None
Software Publishing Corp.	Harvard Graphics for DOS, Harvard Graphics for Windows	Available with support plan	808-274-9715; fax, 408-980-0729; fax-back, 800-735-2228	9:00-9:00 M-F	30 days from first call	900-555-4321 (\$2)	CompuServe (GO SPCFORUM)	408-986-0432, 408-986-1272
Symantec Corp.	Q&A	Available with support plan	503-465-8600; fax-back for literature, 800-554-4403; fax-back for tech notes, 503-984-2490	Toll number: 10:00-7:00 M-F	90 days from first call	900-646-0002 (\$2)	AOL (SYMANTEC), CompuServe (GO SYMANTEC)	503-484-6669, 503-484-6699

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90MHz PENTIUM PROCESSOR

- Mini Tower Model
- 8MB RAM
- 256KB Writeback Cache
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- 4X Multi-session EIDE CD-ROM
- MS Office 4.3, MS Bookshelf, Visio Express for MS Office
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- Spacesaver Keyboard/Mouse
- MS-DOS 6.2/Microsoft Windows 3.1/30 Days Free Support

\$2249

Business Lease: \$83/Mo.
Order Code #500107

DELL DIMENSION P75

75MHz PENTIUM PROCESSOR

- Mini Tower Model
- 8MB RAM
- 256KB Writeback Cache
- 540MB Hard Drive (12ms)
- 15LS Monitor (15" CRT, NI)
- 64-bit PCI 1MB DRAM Video
- 4X Multi-session EIDE CD-ROM
- Sound Blaster 16 Sound Card
- Altec Lansing ACS-5 Speakers
- MS Office 4.3, MS Bookshelf, Visio Express for MS Office
- 3.5" Diskette Drive
- Spacesaver Keyboard/Mouse
- MS-DOS 6.2/Microsoft Windows 3.1/30 Days Free Support

\$1999

Business Lease: \$74/Mo.
Order Code #500100

DELL DIMENSION P75

75MHz PENTIUM PROCESSOR

- Mini Tower Model
- 8MB RAM
- 256KB Writeback Cache
- 540MB Hard Drive (12ms)
- 15LS Monitor (15" CRT, NI)
- 64-bit PCI 2MB DRAM Video
- 3.5" Diskette Drive
- Spacesaver Keyboard/Mouse
- MS-DOS 6.2/Microsoft Windows 3.1/30 Days Free Support

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technical support, a change from last year when both CorelDRAW and Freelance Graphics for Windows received better-than-average scores. PowerPoint was also the most used graphics package in this year's survey (cited by 25 percent of our respondents). Accordingly, it's hard to account for the fact that the package did not get a better-than-average score for overall satisfaction.

Harvard Graphics for DOS was the only package to receive worse-than-average scores for overall satisfaction (a repeat of last year's performance). It also scored worse than average for likelihood of being recommended, as did Freelance Graphics for DOS.

For those of you who were wondering: Since being purchased by Corel Corp., Ventura has much improved its showing in this survey. Although it didn't soar into the better-than-average sphere, it received average scores for the major categories. And unlike last year, it didn't sink to significantly worse than average in any category.

Databases

This year, we started with 14 database products in our survey, 13 of which received at least 50 mentions—the cutoff for inclusion in our survey results because we believe it is the minimum needed for stable data. Only one new product, dBASE for Windows, made it onto the final list. Just as in years past, the databases we cover represent a mix of end user products and tools for developers. The scores of the packages have shifted quite a bit from last year, though; on a positive note, more packages received better-than-average scores for overall satisfaction.

Last year, Microsoft FoxPro for DOS was the lone recipient of a better-than-average score for overall satisfaction, but this year, Clipper, dBASE for Windows, FoxPro for DOS, and Microsoft Access all received better-than-average scores.

Given the increased number of included databases this year, it's also true that more packages received significantly

worse-than-average scores for overall satisfaction. Last year, dBASE and R:BASE were the only two products to be given significantly worse-than-average scores; this year, dBASE for DOS, Paradox for DOS, and R:BASE all shared that dubious distinction.

When asked how likely they would be to recommend the product, our respondents put Microsoft Access at the top of the list. Microsoft Access also happens to have been cited more than twice as often as any other database in our survey. Subscribers also gave better-than-average scores to dBASE for Windows, FoxPro for DOS, and FoxPro for Windows.

The only products to achieve a better-than-average sweep in the three major categories—overall satisfaction, likelihood of being recommended, and overall technical support—were dBASE for Windows and Microsoft Access. The contrast between reader ratings of dBASE for DOS and dBASE for Windows, which was included for the first time this year, was particularly striking. Though dBASE for Windows received better-than-average scores in all the major categories, dBASE for DOS received worse-than-average scores across the board.

Application Suites

We're looking at application suites for the second time, and Microsoft Office appears to have captured a clear position as the strongest player: It was the only suite to receive better-than-average scores for both overall satisfaction and likelihood of being recommended.

On the other hand, none of the application suites received worse-than-average scores for overall satisfaction. And Microsoft Works was the only package given a worse-than-average score for likelihood of being recommended.

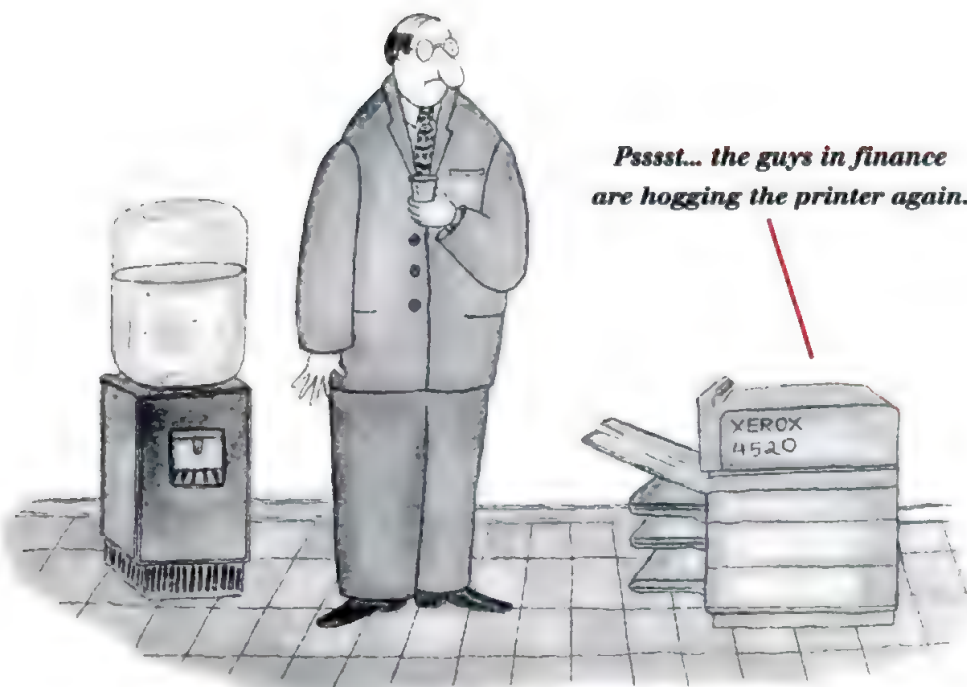
As far as ratings for technical support are concerned, none of the suites were either significantly better or worse than average. When we delved into the particulars of technical support, Novell's PerfectOffice was the only package to receive a better-than-average score, and

HOW READERS RATED TECHNICAL SUPPORT

	Overall support	Documentation	BBS support	Built-in help	Tutorials	Replacement of defective disks
DATABASES						
Alpha Four	7.2 ●	7.7 ▲	6.8 ●	6.9 ●	7.3 ▲	9.3 ▲
Clipper	7.2 ●	7.4 ●	7.9 ●	6.1 ●	5.1 ▼	7.5 ●
dBASE for DOS	7.1 ●	6.9 ▼	6.7 ▼	5.8 ▼	5.8 ▼	7.6 ▼
dBASE for Windows	8.4 ▲	7.8 ▲	7.7 ●	7.6 ▲	7.6 ▲	8.3 ●
Lotus Approach	8.1 ▲	7.6 ●	7.9 ●	7.5 ▲	7.5 ▲	8.9 ●
Microsoft Access	7.9 ▲	7.4 ●	8.0 ▲	7.8 ▲	7.4 ▲	8.9 ▲
Microsoft FoxPro for DOS	7.8 ●	7.3 ●	8.0 ▲	7.3 ▲	6.2 ●	8.2 ●
Microsoft FoxPro for Windows	7.7 ●	7.3 ●	7.6 ●	7.6 ▲	7.0 ●	8.8 ●
Oracle	7.2 ●	7.0 ●	6.9 ●	5.6 ▼	5.2 ▼	8.6 ●
Paradox for DOS	7.4 ●	7.1 ●	7.5 ●	6.3 ▼	6.4 ●	8.2 ●
Paradox for Windows	7.6 ●	7.3 ●	7.2 ●	7.2 ▲	7.0 ▲	8.4 ●
Q&A	7.1 ●	7.3 ●	7.2 ●	7.0 ●	6.8 ●	9.2 ▲
R:BASE	6.9 ●	7.4 ●	6.9 ●	6.1 ●	6.5 ●	8.5 ●
AVERAGE	7.5	7.3	7.4	6.8	6.6	8.5
APPLICATION SUITES						
Lotus SmartSuite for Windows	8.1 ●	7.5 ●	7.7 ●	7.7 ●	7.3 ▼	9.4 ▲
Microsoft Office	7.9 ●	7.4 ▼	7.8 ●	7.8 ●	7.5 ▼	8.6 ●
Microsoft Works	8.0 ●	7.6 ●	7.7 ●	7.8 ●	7.8 ●	8.4 ●
PerfectOffice	8.2 ●	7.7 ●	8.3 ●	8.2 ●	8.3 ▲	8.8 ●
AVERAGE	8.1	7.6	7.9	7.9	7.7	8.8
OPERATING SYSTEMS AND ENVIRONMENTS						
Microsoft Windows	7.4 ●	7.0 ●	7.6 ●	7.0 ●	6.8 ●	8.4 ●
Microsoft Windows NT	7.2 ●	6.9 ●	7.6 ●	6.9 ●	6.2 ●	8.0 ●
MS-DOS	7.6 ●	7.1 ●	7.6 ●	6.9 ●	6.5 ●	8.3 ●
OS/2	7.8 ●	7.2 ●	8.3 ▲	7.8 ▲	7.7 ▲	8.3 ●
PC DOS	7.6 ●	7.2 ●	8.0 ●	6.7 ▼	6.4 ●	8.5 ●
AVERAGE	7.5	7.1	7.8	7.1	6.7	8.3

▲ = Significantly better than average ● = Average ▼ = Significantly worse than average

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5 PPM

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UP TO 16 MB RAM



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600 x 600 DPI

10 PPM

UP TO 8.5 x 14

UP TO 16 MB RAM



4520 LASER

600 x 600 DPI

20 PPM

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UP TO 125 MB

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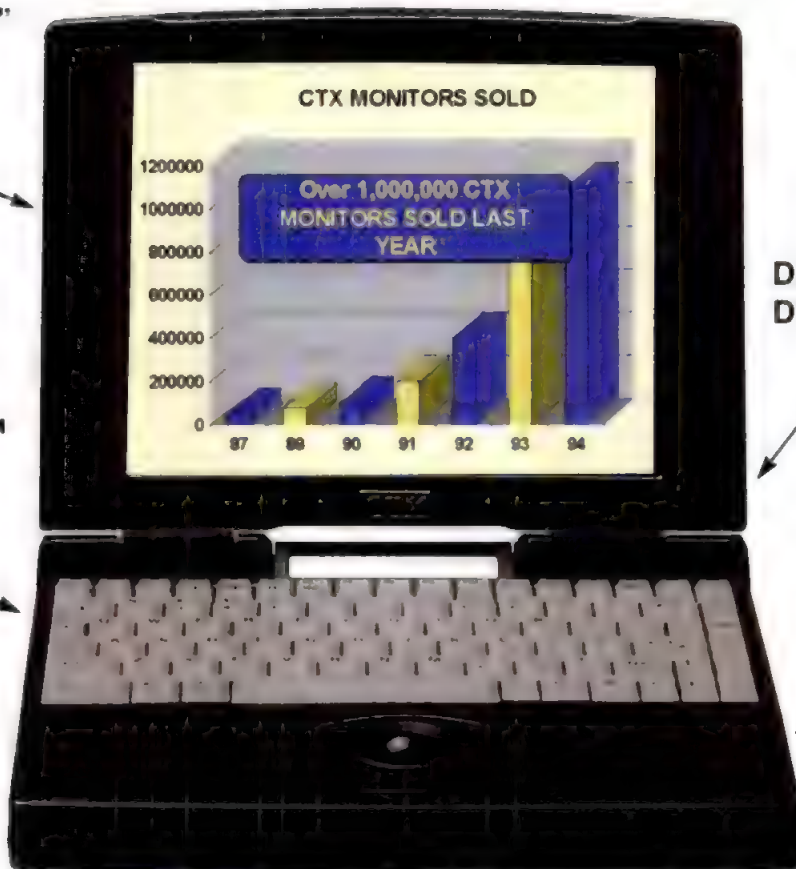
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Support & Satisfaction

TELEPHONE TECHNICAL SUPPORT					
	Number of problems	Users who had to make multiple calls	Connect time (minutes)	Call length (minutes)	Response time (hours)
WORD PROCESSORS					
Ami Pro for OS/2	1.4 ●	25% ●	7.4 ●	10.0 ●	13.6 ●
Ami Pro for Windows	1.3 ●	8% ▲	5.0 ●	7.7 ●	2.0 ●
Microsoft Word for DOS	1.3 ●	14% ●	4.7 ●	4.4 ▲	0.1 ▲
Microsoft Word for Windows	1.7 ●	12% ▲	8.2 ▼	10.6 ▼	2.6 ●
WordPerfect for DOS	2.0 ●	9% ▲	5.7 ●	7.8 ●	1.5 ●
WordPerfect for Windows	2.2 ▼	17% ▼	6.9 ●	10.5 ▼	3.8 ●
AVERAGE	1.6	14%	6.3	8.5	3.9
SPREADSHEETS					
Lotus 1-2-3 for DOS	1.0 ●	7% ●	5.3 ●	6.2 ●	1.5 ▲
Lotus 1-2-3 for OS/2	1.3 ●	14% ●	3.6 ●	6.8 ●	13.7 ●
Lotus 1-2-3 for Windows	1.4 ●	11% ●	6.4 ●	7.6 ●	2.6 ●
Microsoft Excel	1.3 ●	7% ●	6.5 ▼	8.6 ▼	2.0 ●
Quattro Pro for DOS	1.1 ●	7% ●	4.3 ●	4.7 ●	4.8 ●
Quattro Pro for Windows	1.1 ●	8% ●	5.2 ●	6.6 ●	2.8 ●
AVERAGE	1.2	9%	5.2	6.7	4.6
GRAPHICS APPLICATIONS					
Adobe PageMaker	1.9 ▼	19% ▼	7.9 ●	10.5 ●	3.6 ●
Adobe Photoshop	1.3 ●	12% ●	9.1 ●	13.6 ▼	6.3 ●
Core! Ventura	2.9 ▼	17% ●	7.8 ●	8.9 ●	2.8 ●
Core!DRAW	1.4 ●	15% ●	8.1 ▼	9.6 ●	5.9 ▼
Freelance Graphics for DOS	0.6 ●	6% ●	6.7 ●	6.0 ●	N/A
Freelance Graphics for Windows	0.7 ▲	6% ▲	3.4 ▲	4.7 ▲	2.9 ●
Harvard Graphics for DOS	0.9 ●	5% ▲	1.0 ▲	1.3 ▲	0.1 ▲
Harvard Graphics for Windows	0.9 ●	16% ●	4.9 ●	5.2 ▲	4.2 ●
Micrografx Designer	1.1 ●	13% ●	8.3 ●	11.3 ●	0.6 ▲
Microsoft PowerPoint	0.6 ▲	4% ▲	5.0 ●	5.1 ▲	2.7 ●
AVERAGE	1.2	11%	6.2	7.6	2.9
DATABASES					
Alpha Four	1.6 ●	20% ●	9.4 ●	11.5 ●	5.6 ●
Clipper	2.1 ●	15% ●	8.2 ●	7.2 ●	1.8 ●
dBASE for DOS	1.1 ▲	6% ▲	4.6 ▲	6.0 ●	1.7 ●
dBASE for Windows	1.6 ●	7% ▲	3.6 ▲	4.9 ▲	2.3 ●
Lotus Approach	1.3 ●	11% ●	5.5 ●	9.8 ●	3.4 ●
Microsoft Access	1.9 ●	9% ▲	6.8 ●	9.5 ●	2.6 ●
Microsoft FoxPro for DOS	2.5 ●	11% ●	6.6 ●	10.1 ●	2.4 ●
Microsoft FoxPro for Windows	2.3 ●	14% ●	8.1 ●	10.5 ●	3.2 ●
Oracle	3.7 ▼	26% ▼	11.8 ▼	14.2 ▼	13.1 ▼
Paradox for DOS	1.2 ▲	12% ●	6.5 ●	8.4 ▼	3.2 ●
Paradox for Windows	2.0 ●	12% ●	6.8 ●	7.9 ●	2.9 ●
Q&A	1.2 ▲	14% ●	5.6 ●	8.0 ●	6.0 ●
R:BASE	2.6 ●	14% ●	6.8 ●	7.6 ●	2.7 ●
AVERAGE	1.9	13%	6.9	9.0	3.9
APPLICATION SUITES					
Lotus SmartSuite for Windows	1.1 ●	8% ●	6.5 ●	8.8 ●	4.8 ●
Microsoft Office	1.0 ●	8% ▲	6.1 ●	6.8 ●	1.8 ●
Microsoft Works	1.0 ●	9% ●	6.3 ●	8.4 ●	3.0 ●
PerfectOffice	1.8 ●	10% ●	5.9 ●	6.5 ●	0.8 ●
AVERAGE	1.2	8%	6.2	7.6	2.6
OPERATING SYSTEMS AND ENVIRONMENTS					
Microsoft Windows	1.8 ●	13% ●	8.8 ●	11.7 ●	3.4 ●
Microsoft Windows NT	2.6 ●	17% ●	12.1 ●	18.2 ▼	8.5 ●
MS-DOS	1.0 ▲	8% ▲	7.0 ●	8.2 ▲	2.1 ▲
OS/2	3.0 ▼	22% ▼	8.1 ●	14.3 ●	9.4 ▼
PC DOS	1.3 ●	8% ▲	5.0 ▲	5.3 ▲	0.8 ▲
AVERAGE	1.9	14%	8.2	11.5	4.8

▲ = Significantly better than average ● = Average ▼ = Significantly worse than average
N/A Not applicable. None of the survey respondents rated the product in this category

that was for its tutorials. Microsoft Office—a leader in other categories, as noted above—earned a worse-than-average score for documentation and tutorials.

When we looked at how satisfied readers were with technical support for the individual applications within a suite, however, we found quite a contrast: Many suite components (especially the spreadsheets) received better-than-average scores for their overall technical support. So if you're considering purchasing a suite and are concerned about technical support, looking at the scores for the individual applications should help give you the big picture.

Operating Systems & Environments

Once again, OS/2 users showed their undying dedication to their chosen operating system, even though OS/2 represents only a tiny segment of systems rated (4 percent). Just as in last year's survey, OS/2 was the only operating system that scored significantly better than average for overall satisfaction. In another repeat performance, Microsoft Windows again received a significantly worse-than-average score for overall satisfaction—and was the only operating system to be rated that way by our subscribers.

OS/2 also received a significantly better-than-average score for likelihood of being recommended, and this year it didn't have to share that honor with Microsoft Windows. PC DOS was the only operating system to receive a worse-than-average score in this area.

None of the operating systems received better-than-average scores for overall technical support. But when we delved into the discrete aspects of support, OS/2 was given significantly better-than-average scores for its BBS support, built-in help, and tutorials.

Because of Windows, DOS, and now the emergence of Windows NT, Microsoft's operating systems naturally account for the vast majority of those rated. But with OS/2 Warp's fairly recent arrival and Windows 95 on the way, who knows what changes are in store for next year? □

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Market Share
Windows Illustration
Software
PC Data,
December Sales, 1994

CorelDRAW NUMBER ONE in ILLUSTRATION

Company	Units	Sales
Corel	7609	1,586,519.83
Adobe	257	73,968.64
Micrografx	380	36,696.35
Deneba	98	15,899.24
Totals	8,344	1,713,083.90



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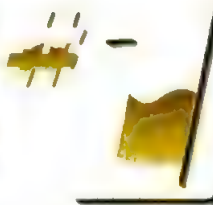
Corel VENTURA^{*} NUMBER ONE in PUBLISHING



Product	S.L.P. (US\$)	Score
Corel VENTURA 5	\$595	6.8
QuarkXPress	\$895	6.7
Aldus PageMaker	\$895	6.2

INFOWORLD
Report Card Rating,
Desktop Publishing Software
March 20, 1995

3.5" disk version



Corel PHOTO-PAINT^{*} NUMBER ONE in IMAGE-EDITING

Product	S.L.P. (US\$)	Overall weighted score
Corel PHOTO-PAINT 5 Plus	\$249	44
Micrografx Picture Publisher 5.0	\$595	42
Adobe PhotoShop 3.0	\$895	39
Fractal Design Painter 3	\$499	38

PC World
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KUB-0113



THE TOP 200

You buy their hardware, you buy their software, but how much do you really know about the companies you buy from?
Here are their financial nuts and bolts.

In the 1990s, if your business is PCs, you can never be too strong, too thin, or too financially stable. And certainly you can't be too complacent. This year's *PC Magazine 200* offers financial profiles of the top players in the PC industry. We list PC manufacturers, software companies, and makers of components including networking hardware, printers, monitors, hard disks, CD-ROM drives, video boards, and sound boards.

Not unexpectedly, even as this industry matures and the players consolidate, there's still plenty of room for financial comings and goings. Examining the *PC Magazine 200* can add an important dimension—fiscal reliability—to your "perfect" purchase.

On the following pages we rank the leading companies in each area by revenue. A complete discussion of our methodology appears after these listings.

M&A ACTION

Mergers and acquisitions came fast and furiously, with the net result being a consolidation of some major power centers. Some notables included: Aldus and Adobe, Novell and WordPerfect, Sybase and Powersoft, SynOptics and Wellfleet, and PC manufacturers Micron and ZEOS.

THERE'S BIG AND THEN THERE'S BIG

We were struck by many things as we compiled these numbers. Here are a few of the highlights.

Though Microsoft is twice as large as its closest com-

petitor in software, in the Fortune 500 it ranks dead center at number 250.

Computer Associates, Digital, and Oracle fall in the top 15 if you count total software revenues; if you count only PC-based revenues, as we did, they lose ground.

In the past year, Borland—once the industry's third-largest software company—has suffered through a 54 percent reduction in staff and a 47 percent drop in revenue.

Edutainment company Broderbund makes it into the big league of software applications, ranked at number 27 with revenues of \$112 million. Spectrum HoloByte follows at number 38 with \$69 million. Of course, these numbers pale alongside those of Hollywood entertainment conglomerates.

Hewlett-Packard holds the number-one position in printer sales regardless of whether its ink jet or LaserJet divisions are counted separately. HP sells more ink jets, but gets more revenue from LaserJet sales.

Powerhouses in their own rights, SynOptics and Wellfleet are now combined as Bay Networks, which occupies the number-two position in networking, behind IBM.

Creative Labs is the General Motors of the sound board industry. Not resting on its laurels, it is branching out into videoconferencing, telephony, mass storage, and software.

The top three PC vendors have maintained their turf, but the direct-mail companies are not far behind.

—Robin Raskin

THE PC MAGAZINE 200

Vendor Financial Information

Continues

Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	U.S. PC revenues, 1994 (millions)	Units sold in U.S., 1994 (thousands)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
PCs									
1	IBM Personal Computer Co.	Unit 1, 1000 Rd. Armonk, NY 10504 800-426-3333	Rick Truitt, senior vice president and group executive	8,000	\$6,215	1,349	IBM Corp. (1914)	Public	\$64,052
2	Compaq Computer Corp.	P.O. Box 692000, Houston, TX 77269-2000 800-345-1518, 713-378-8820, fax, 713-378-1442	Eckhard Pfeiffer, president and CEO	14,372	\$5,473	2,335	Compaq Computer Corp. (1982)	Public	\$10,900
3	Apple Computer Inc.	1 Infinite Loop, Cupertino, CA 95014 800-767-2775	Michael H. Spindler, president and CEO	14,592	\$4,982	2,165	Apple Computer Inc. (1977)	Public	\$9,500
4	Packard Bell Electronics Inc.	31717 La Tenda Dr., Westlake Village, CA 91362, 800-733-5858, 818-865-1555, fax, 818-865-0178	Benny Alagani, CEO	2,964	\$2,555	1,678	Packard Bell Electronics Inc. (1986)	Private	\$3,000
5	Gateway 2000 Inc.	610 Gateway Dr., P.O. Box 80, North Sioux City, SD 57049, 800-846-2000, 605-232-2000, fax, 605-232-2023	Test-Walt, chairman and CEO	5,400	\$2,511	988	Gateway 2000 Inc. (1985)	Public	\$2,701
6	Dell Computer Corp.	2214 W. Braker Lane, Austin, TX 78758 800-613-3355, 512-338-4400, fax, 800-727-8320	Dick Snyder, general manager (Americas)	4,500	\$2,300	963	Dell Computer Corp. (1984)	Public	\$3,500
7	Hewlett-Packard Personal Information Products Group	3000 Hanover St., Palo Alto, CA 94304 800-752-0900	Richard Watts, president and general manager	1,100	\$1,895	433	Hewlett-Packard Co. (1939)	Public	\$26,613
8	NEC Technologies Inc.	1414 Massachusetts Ave., Boxborough, MA 01719, 800-632-4636, 508-264-8000	James R. Bennett, CEO	2,000	\$1,787	513	NEC Corp. (1899)	Public	\$35,000
9	Toshiba America Information Systems Inc., Computer Systems Division	P.O. Box 19224, Irvine, CA 92713-9224 800-334-3445, 714-583-3000	Atsushi Nishida, president	400	\$1,683	618	Toshiba Corp. (1875)	Public	\$42,900
10	AST Research Inc.	16215 Alton Pkwy., Irvine, CA 92718 800-876-4278, 714-727-4141, fax, 800-926-1278	Safi Qureshey, chairman and CEO	6,000	\$1,408	683	AST Research Inc. (1980)	Public	\$2,367
11	Omni Equipment Corp. Personal Computer Business Unit	100 N. Main St., Andover, MA 01810-0499 800-722-9332, 603-884-4304, fax, 800-524-5694	Bernhard Auer, vice president and general manager	3,500	\$1,216	341	Omni Equipment Corp. (1957)	Public	\$13,400
12	AT&T Global Information Solutions	1700 S. Patterson Blvd., Dayton, OH 45479 800-447-1124, 513-445-5000	Lars Nyberg, CEO	1,300	\$890	443	AT&T Corp. (1885)	Public	\$78,000
13	Epson America Inc.	20701 Madison Ave., Torrance, CA 90503 800-289-3776, 310-782-0770, fax, 310-782-4248	Norio Kawada, president	700	\$848	278	Sanki-Epson Corp. (1942)	Private	\$4,600
14	Acer America Corp.	2641 Orchard Pkwy., San Jose, CA 95134 800-733-2237, 408-432-6200, fax, 408-922-2933	Ronald Chwang, president and COO	900	\$659	465	Acer Group Inc. (1976)	Public	\$3,200
15	Unisys Corp. Client Server Systems (IBU)	2100 N. First St., San Jose, CA 95134 800-448-1424, 716-292-0880, fax, 716-292-6671	Frank W. Brandenburg, president	1,750	\$500	125	Unisys Corp. (1986)	Public	\$7,400
16	Micron Computer Inc. (now a part of Micron Electronics Inc.)	900 E. Kiercher Rd., Nampa, ID 83647-3045 800-438-3343, 208-483-3434, fax, 208-483-3424	Joseph Dattoso, president, chairman, and CEO, (Micron Electronics Inc.)	1,500	\$499	185	Micron Technology Inc. (1978)	Public	\$1,630
17	Zenith Data Systems	2750 E. Lake Cook Rd., Buffalo Grove, IL 60089, 800-582-0524, 708-808-5000	Joseph Dattoso, president and CEO	1,200	\$357	140	Groupe Bull. (1931)	Public	\$5,388
18	ZEOS International Ltd. (now a part of Micron Electronics Inc.)	1301 Industrial Blvd., Minneapolis, MN 55413 800-554-7172, 612-362-1234, fax, 800-362-1205	Joseph Dattoso, president, chairman, and CEO (Micron Electronics Inc.)	550	\$266	136	Micron Technology Inc. (1978)	Public	\$1,630
19	Texas Instruments Inc. Personal Productivity Products	5101 Airport Rd., Temple, TX 76788-6100 800-848-3927, 817-771-5856, fax, 817-774-6660	Robert Chatterjee, president	2,500	\$235	76	Texas Instruments Inc. (1930)	Public	\$10,315
20	Leading Edge Products Inc.	117 Flanders Rd., Westborough, MA 01581 800-874-3340, 508-836-4800, fax, 508-836-4504	Michael Morand, president and CEO	110	\$198	190	Daewoo Telecom. (1983)	Private	\$749
21	IPC Technologies Inc. (formerly Austin Direct)	15000 Melrose Blvd., Austin, TX 78708 800-849-8681, 512-339-3500, fax, 512-454-1357	David J. Blum, president and CEO	350	\$188	87	IPC Corp. (1985)	Public	\$900
22	MidWest Micro	6910 U.S. Route 36 East, Fletcher, OH 45326 800-445-2035, 513-368-2309, fax, 800-562-6622	Mark Runkle, president	650	\$176	96	Infotel Inc. (1982)	Private	\$294
23	Everex Systems Inc.	5400 Brandeis St., Fremont, CA 94538 800-821-0806, 510-498-1111, fax, 510-683-2186	Uher Wang, president	200	\$150	85	Formosa Plastics Group (1947)	Public	\$12,000
24	DFI Inc.	135 Main Ave., Sacramento, CA 95838-2041 800-808-4334, 916-568-1234, fax, 916-568-1233	David C. Lu, president	380	\$139	73	DFI Inc. (1985)	Private	\$139
25	Comtrade	1218 Bixby Dr., Chapel Industry, CA 91745 800-959-2123, 818-961-6688, fax, 818-369-1479	Christopher Luke, president	110	\$130	65	Comtrade (1987)	Private	\$130
26	Samsung Electronics America Inc.	105 Challenger Rd., Ridgeland Park, NJ 07660 800-933-4110, 201-229-4000, fax, 201-229-4029	K. R. Song, president	400	\$130	63	Samsung Group (1938)	Public	\$54,000
27	Mitsuba Corp.	1905 Wright Ave., La Verne, CA 91790 800-648-7822, 909-392-2000, fax, 909-392-2021	Jim Chen, president	110	\$115	30	Mitsuba Corp. (1982)	Private	\$420
28	Advanced Logic Research Inc.	9401 Jeronimo Irvine, CA 92718, 800-444-4257, 714-581-6770, fax, 714-581-9240	Gene Lu, president and CEO	450	\$114	49	Advanced Logic Research Inc. (1984)	Public	\$179

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Vendor Financial Information

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PCs									
29	CompUSA [§]	14951 N. Dallas Parkway, Dallas, TX 75240 800-266-7872, 214-383-4000	Jim Haggin, CEO	N/A	\$100	100	CompUSA (1984)	Public	\$2,520
30	DTK Computer Inc.	770 Epperson Dr., City of Industry, CA 91748 800-289-2395, 818-810-0098, fax: 818-810-0090	Duke Liao, president	350	\$99	46	DTK Computer Inc. (1981)	Private	\$99
31	CompuAdd Corp.	12337 Technology Blvd., Austin, TX 78757 800-627-1967, 512-250-1489, fax: 512-331-2862	Richard Thomas, president and CEO	160	\$83	33	CompuAdd Holdings Inc. (1994)	Private	\$100
32	Memorex Telex Corp.	545 E. John Carpenter Freeway, Irving, TX 75062, 800-944-4455 ext. 7788, 214-444-3500, fax: 214-444-3501	Marcelo Gumbao, CEO	N/A	\$78	23	Memorex Telex N.V. (1961)	Public	\$934
33	Insight Enterprises Inc.	1910 W. Fourth St., Tempe, AZ 85281 800-729-0770, 602-902-1176, fax: 602-902-1180	Eric J. Brown, CEO	508	\$72	35	Insight Enterprises Inc. (1988)	Public	\$217
34	USA Flex Inc. and Affiliates	471 Brighton Dr., #600, Bloomingdale, IL 60108 800-872-3539, 708-351-9700, fax: 708-351-7204	Alicia Evans, vice president (sales)	450	\$68	22	USA Flex Inc. and Affiliates (1977)	Private	\$411
35	AMS Inc.	12881 Ramona Blvd., Irvine, CA 92618 800-886-2671, 818-814-8851, fax: 818-814-0782	Mei Chen, president	107	\$67	27	AMS Inc. (1985)	Private	\$67
36	GST/Micro City	17707 Valley View Blvd., Cerritos, CA 90703 800-587-2764, 714-719-0106, fax: 714-739-8291	J. P. Wong, CEO	94	\$60	24	GST/Micro City (1984)	Private	\$60
37	Lancom Computer Systems Inc.	2995 Redmont Ave., Costa Mesa, CA 92626 800-848-4123, 714-438-3000	Richard Toulton, president and CEO	306	\$56	21	Lancom Inc. (1937)	Public	\$19,300
38	Dyna Micro Inc.	48434 Milmont Dr., Fremont, CA 94538 800-336-3962, 510-438-0233, fax: 510-353-2020	Victor Wu, president and CEO	60	\$52	21	Fora Inc. (1990)	Private	\$120
39	Zenon Technology Inc.	18342 Dale Ave., City of Industry, CA 91748 800-899-6119, 818-935-1828, fax: 818-935-1826	Jesse Luk, president	10	\$48	23	Zenon Technology Inc. (1991)	Private	\$48
40	Dynamic Decisions Inc.	53 Murray St., New York, NY 10007-2201 800-869-9888, 212-227-9888, fax: 212-227-9610	Peter Phame, president	95	\$46	20	Dynamic Decisions Inc. (1978)	Private	\$46
41	EPS Technologies Inc.	10050 Dakota Ave., P.O. Box 278, Jeffersville, SD 57038-0278, 800-447-0921, 605-966-5586, fax: 605-966-5482	Ed Krieger, president	50	\$43	15	EPS Technologies Inc. (1989)	Private	\$43
42	Data Storage Marketing Inc.	5718 Central Ave., Boulder, CO 80301 800-543-6098, 303-442-4747, fax: 303-442-7985	Tom Ward, president	175	\$39	15	Data Storage Marketing Inc. (1986)	Private	\$120
43	Micro Express	1501 Jamieson Ave., Santa Ana, CA 92705 800-989-9900, 714-852-1400, fax: 714-852-1225	Art Afshan, president	85	\$39	26	Micro Express (1986)	Private	\$39
44	Tri-Star Computer	2424 W. 14th St., Tempe, AZ 85281-6900 800-800-7668, 602-731-4926, fax: 602-731-4979	Bob Powers, president	140	\$39	10	Tri-Star Computer (1988)	Private	\$39
45	Orvett, North America Inc.	22425 E. Appleway Ave., Gilbert, AZ 85406 98019-9534, 800-633-9909, 509-927-7050, fax: 509-927-5700	Ted DeMent, CEO	1,125	\$37	13	Ing. C. Orvett & C. SpA (1908)	Public	\$5,700
46	Altima Systems Inc.	2440 Stanwell Dr., Concord, CA 94520 800-356-9990, 510-356-5600, fax: 510-356-7408	Steve Hagman, executive vice president and general manager	25	\$32	16	Altima Systems Inc. (1988)	Private	\$32
47	EDW Systems Inc.	740 N. Mary Ave., Sunnyvale, CA 94086 800-827-5806, 408-245-5836, fax: 408-245-3108	Eduardo Isai, CEO	60	\$22	10	EDW Enterprise Inc. (1987)	Private	\$22
48	Duracom Computer Systems Inc.	1425 Greenway Dr., Irving, TX 75093 800-551-9000, 214-518-1200, fax: 214-518-1090	Tom Dodson, president	85	\$21	13	Duracom Computer Systems Inc. (1989)	Private	\$21
49	BTG Inc.	2802 Merilee Dr., Fairfax, VA 22031 703-641-1200, fax: 703-876-1920	Tom Nixon, vice president	150	\$17	5	BTG Inc. (1982)	Public	\$150
50	NETis Technology Inc.	1606 Centre Pointe Dr., Milpitas, CA 95035 800-577-7526, 408-263-0368, fax: 408-263-4624	Susan Liang, president	34	\$17	10	NETis Technology Inc. (1990)	Private	\$17

N/A Not applicable. This company does not manufacture its own PCs.

§ CompUSA's PCs are sold under the brand name Compudyne.

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PC SOFTWARE								
1	Microsoft Corp.	One Microsoft Way, Redmond, WA 98052-6399 800-426-9400	William H. Gates III, chairman and CEO	11,644	\$5,300	Microsoft Corp. (1975)	Public	\$5,300
2	Novell Inc. (now owns WordPerfect Corp.)	1555 N. Technology Way, Orem, UT 84057 800-453-1267, 801-429-7000	Robert Frankenberg, president, chairman, and CEO	7,900	\$1,998	Novell Inc. (1983)	Public	\$1,998
3	Lotus Development Corp.	55 Cambridge Pkwy., Cambridge, MA 02142 800-343-5414, 617-577-8500	Jim Manzi, president and CEO	5,519	\$971	Lotus Development Corp. (1982)	Public	\$971
4	Adobe Systems Inc. (now owns Aldus Corp.)	1585 Charleston Rd., Mountain View, CA 94039 800-833-8687, 415-961-4400, fax: 415-631-3796	Charles Geschke, president, and John Warnock, CEO	1,584	\$598	Adobe Systems Inc. (1982)	Public	\$598

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Max Resol.	1280 x 1024 @ up to 66Hz
Standards	MPR-II, TCO
F2-17	
Dot Pitch	0.28mm
Scan Freq.	H:30-69kHz, V:55-120kHz
Res. Resol.	1024 x 768 @ up to 87Hz
Max Resol.	1280 x 1024 @ up to 66Hz
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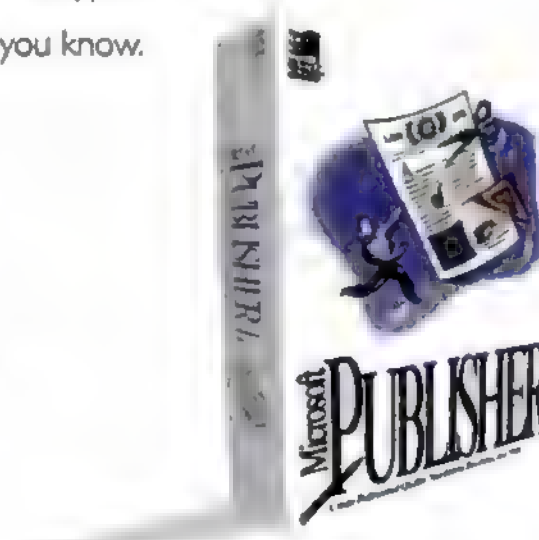
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PC SOFTWARE								
5	IBM Personal Software Products Division	11400 Burnet Rd., Austin, TX 78758; 800-426-3333, 512-823-0000	Leland R. Reiswig, Jr., general manager	2,300	\$575	IBM Corp. (1914)	Public	\$64,052
6	CompuServe Inc. (now owns SPRY Inc.)	5000 Arlington Centre Blvd., Columbus, OH 43220; 800-848-8199, 614-529-1349; fax, 614-529-1610	Maunce A. Cox, president and CEO	2,400	\$541*	H & R Block Inc. (1946)	Public	\$1,361*
7	Autodesk Inc.	111 McInnis Pkwy., San Rafael, CA 94903; 800-226-3601, 415-507-5000; fax, 415-507-5100	Carol Bartz, president, chairman, and CEO	1,788	\$455	Autodesk Inc. (1982)	Public	\$455
8	Intergraph Software Solutions	Huntsville, AL 35894-0001; 800-345-4876, 205-730-2700; fax, 205-730-9441	Tommy D. Steele, president	1,974	\$425	Intergraph Corp. (1969)	Public	\$1,041
9	Attachmate Corp. (now owns Digital Communications Associates Inc.)	3617 131st Ave. SE, Bellevue, WA 98006; 800-426-6283, 206-644-4010; fax, 206-747-9924	James Lindner, president and COO	2,000	\$390	Attachmate Corp. (1983)	Private	\$390
10	IBM Software Solutions Division	Route 100, Somers, NY 10589; 800-426-3333; 914-768-1900	Steven A. Mills, general manager	5,200	\$325	IBM Corp. (1914)	Public	\$64,052
11	Intuit Inc.	155 Linfield Ave., Menlo Park, CA 94026; 800-624-8742, 415-858-6004; fax, 415-462-2955	William Campbell, president and CEO	2,300	\$289	Intuit Inc. (1983)	Public	\$289
12	Symantec Corp.	10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 503-334-6054; fax, 503-334-7474	Gordon E. Eubanks, president and CEO	1,500	\$268	Symantec Corp. (1982)	Public	\$268
13	Borland International Inc.	100 Borland Way, Scotts Valley, CA 95066; 800-331-0877, 408-461-9000; fax, 408-431-4122	Gary A. Wetzel, president	950	\$250	Borland International Inc. (1983)	Public	\$250
14	Oracle Corp.	500 Oracle Pkwy., Redwood Shores, CA 94065; 800-672-2531, 415-506-7000	Lawrence J. Ellison, president and CEO	16,083	\$219	Oracle Corp. (1977)	Public	\$2,378
15	America Online Inc.	8619 Westwood Center Dr., Vienna, VA 22182-2285; 800-827-6364, 703-448-8700; fax, 703-448-0793	Stephen M. Case, CEO	1,513	\$201	America Online Inc. (1985)	Public	\$201
16	Prodigy Services Co.	445 Hamilton Ave., White Plains, NY 10601; 800-776-3449, 914-448-8000; fax, 914-448-8083	Ed Bennett, president and CEO	550	\$200	Sears, Roebuck and Co. (1886); IBM Corp. (1914)	Public	\$54,559 (Sears); \$64,052 (IBM)
17	The Santa Cruz Operation Inc.	400 Encinal St., P.O. Box 1900, Santa Cruz, CA 95061-1900; 800-726-8649, 408-425-7222; fax, 408-458-4227	Alok Mohan, president and COO	1,330	\$184	The Santa Cruz Operation Inc. (1979)	Public	\$184
18	Corel Corp.	1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7; 800-772-6735, 613-728-8200; fax, 613-761-9176	Michael Cowpland, president and CEO	450	\$164	Corel Corp. (1985)	Public	\$164
19	Claris Corp.	5201 Patrick Henry Dr., Santa Clara, CA 95052; 800-325-2747, 408-727-8227; fax, 408-987-3900	Guerrino De Luca, president	700	\$160	Apple Computer Inc. (1977)	Public	\$9,500
20	Banyan Systems Inc. (now owns Beyond Inc.)	120 Flanders Rd., Westboro, MA 01581; 800-222-6926, 508-898-1000; fax, 508-898-1755	David C. Mahoney, chairman and CEO	850	\$150	Banyan Systems Inc. (1983)	Public	\$150
21	Digital Equipment Corp.	111 Powdermill Rd., Maynard, MA 01754; 800-344-4825, 508-493-5111; fax, 508-493-8780	Enrico Pesatori, vice president of computer systems division	Info not available	\$140	Digital Equipment Corp. (1957)	Public	\$13,400
22	Micro Focus Inc.	2465 E. Bayshore Rd., Palo Alto, CA 94303; 800-872-6265, 415-856-4161; fax, 415-856-6134	Paul O'Grady, CEO, and Brian Reynolds, chairman	788	\$139**	Micro Focus Inc. (1976)	Public	\$139**
23	Powersoft Corp.	561 Virginia Rd., Concord, MA 01742; 800-395-3525, 508-287-1500; fax, 508-369-5185	Mitchell Kertzman, chairman and CEO	850	\$133	Sybase Inc. (1984)	Public	\$694
24	SoftKey International Inc.	One Athenaeum St., Riverview Bldg., Cambridge, MA 02142; 800-227-5609, 617-494-1200; fax, 617-494-1219	Kevin O'Leary, president	450	\$121	SoftKey International Inc. (1982)	Public	\$121
25	Computer Associates International Inc.	One Computer Associates Plaza, Islandia, NY 11788-7000; 800-225-5224, 516-342-5224; fax, 516-342-5734	Charles B. Wang, chairman and CEO	8,000	\$120	Computer Associates International Inc. (1976)	Public	\$2,400
26	Quark Inc.	1800 Grant St., Denver, CO 80203; 800-788-7835, 303-894-8888; fax, 303-894-3399	Tim Gill, chairman	420	\$120	Quark Inc. (1981)	Private	\$120
27	Broderbund Software Inc.	504 Redwood Blvd., Novato, CA 94948; 800-521-6263, 415-382-4400; fax, 415-382-4419	Doug Carlston, CEO	450	\$112	Broderbund Software Inc. (1980)	Public	\$112
28	Intersolv Inc. (now owns Q+E Software)	3200 Tower Oaks Blvd., Rockville, MD 20852; 800-582-1600, 301-230-3200; fax, 301-231-7813	Kevin J. Burns, president and CEO	700	\$110	Intersolv Inc. (1982)	Public	\$110
29	Cheyenne Software Inc.	3 Expressway Plaza, Roslyn Heights, NY 11577; 800-243-9462, 516-484-5110; fax, 516-484-3446	Rei Jane Huar, president and CEO	500	\$105	Cheyenne Software Inc. (1983)	Public	\$105
30	Wall Data Inc.	11332 NE 122nd Way, Kirkland, WA 98034; 800-487-8622, 206-814-9255; fax, 206-814-4309	James Simpson, president and CEO	650	\$101	Wall Data Inc. (1982)	Public	\$101
31	SAP America Inc.	300 Stevens Dr., Philadelphia, PA 19113; 800-727-5872, 610-521-4500; fax, 610-595-4910	Klaus P. Beiser, president and CEO	1,000	\$97	SAP AG (1972)	Public	\$1,130
32	SAS Institute Inc.	SAS Campus Dr., Cary, NC 27513; 919-677-8000; fax, 919-677-4444	James H. Goodnight, president	3,200	\$96	SAS Institute Inc. (1976)	Private	\$482
33	Delrina Corp.	6320 San Ignacio Ave., San Jose, CA 95119-1209; 800-268-6082, 408-363-2345; fax, 408-363-2340	Dennis Bennie, chairman and CEO, and Mark Skapinker, president	700	\$95	Delrina Corp. (1988)	Public	\$95

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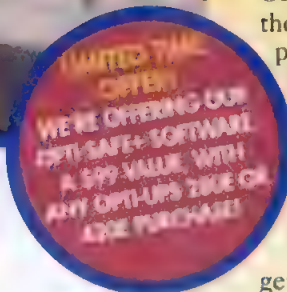
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Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	Worldwide PC software net revenues, 1994 (millions)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
PC SOFTWARE								
34	Walker-Hitch & Quinn Inc.	1500 Dexter Ave. North, Seattle, WA 98109, 800 872-2829, 206-217-7100, fax, 206-217-0293	Doug Walker, president	392	\$89	Walker-Hitch & Quinn (1981)	Private	\$89
35	Davidson & Associates Inc.	19840 Pioneer Ave., Torrance, CA 90503 800 545-7677, 310 793 0600, fax, 310-793 0601	Janice G. Davidson, president	565	\$88	Davidson & Associates Inc. (1982)	Public	\$88
36	Sybase Inc. (now owns Powersoft Corp.)	6475 Christie Ave., Emeryville, CA 94608, 800 879-2273, 510-922 3500, fax, 510 656-9441	Mark B. Hoffman, president, chairman, and CEO	5 400	\$75***	Sybase Inc. (1984)	Public	\$694***
37	Frame Technology Corp.	333 W. San Carlos St., San Jose, CA 95110, 800 843-7263, 408 975 6000, fax, 408 975-6500	L. George Klaus, president and CEO	500	\$73	Frame Technology Corp. (1986)	Public	\$73
38	Spectrum HoloByte Inc. (now owns MicroProse Inc.)	2490 Mariner Square Loop, Alameda, CA 94501, 800 695-4263, 510-522 3584, fax, 510-522-3587	Gilman Louie, chairman and CEO	460	\$69	Spectrum HoloByte Inc. (1986)	Public	\$88
39	Gupta Corp.	1060 Marsh Rd., Menlo Park, CA 94025, 800 876 3267, 415 321 9500, fax, 415 321 5471	Umang Gupta, chairman and CEO and Sam Inman, president and COO	400	\$65	Gupta Corp. (1984)	Public	\$65
40	Sierra On-Line Inc.	3380 146th Pl. SE, #300, Bellevue, WA 98007, 800 TKT-TKTK, 206-649 9800, fax, 206-641-7617	Ken Williams, president and CEO	700	\$63	Sierra On-Line Inc. (1979)	Public	\$63
41	Software Publishing Corp.	3165 Kifer Rd., P.O. Box 54983, Santa Clara, CA 95056 0983, 800 234 2500, 408 986 8000, fax, 408 980 0729	Irfan Salim, president and CEO	230	\$62	Software Publishing Corp. (1980)	Public	\$62
42	NetManage Inc.	10725 N. De Anza Blvd., Cupertino, CA 95014, 800 TKT-KTKT, 408-973-7171, fax, 408-257-6405	Zvi Alon, president and CEO	350	\$62	NetManage Inc. (1990)	Public	\$62
43	IRI Software (An Information Resources Inc. Business)	200 Fifth Ave., Waltham, MA 02154, 800 765 7227, 617 890 1100, fax, 617 890 4660	Jeffrey P. Stamen, president	1 100	\$61	Information Resources Inc. (1977)	Public	\$1 100
44	Dun & Bradstreet Software Services Inc.	3445 Peachtree Rd. NE, Atlanta, GA 30326, 800 290 7374, 404 239 4636, fax, 404 239-4933	Doug MacIntyre, president and CEO	2 000	\$60	The Dun & Bradstreet Corp. (1841)	Public	\$4 900
45	Caere Corp.	100 Cooper Ct., Los Gatos, CA 95030, 800 535-7223, 408 395 7000, fax, 408 395-2743	Steve Humphreys, president	250	\$59	Caere Corp. (1976)	Public	\$59
46	Micrografx Inc.	1303 E. Arapaho Rd., Richardson, TX 75081, 800 733-3729, 214-234-2694, fax, 214 994 6475	J. Paul Grayson, chairman and CEO	234	\$58	Micrografx Inc. (1982)	Public	\$58
47	Interplay Productions Inc.	17922 Fitch Ave., Irvine, CA 92714, 800 468 3775, 714 553 6555, fax, 714 553 1406	Brian Fargo, president	240	\$57	Interplay Productions Inc. (1983)	Private	\$57
48	Legent Corp.	575 Herndon Pkwy., Herndon, VA 22070-5226, 800-676-5468, 703-708-3000, fax, 703 708-3209	Jerro L. Stead, president and CEO	2 709	\$55	Legent Corp. (1989)	Public	\$507
49	Parsons Technology Inc.	One Parsons Dr., Hawatha, IA 52233 0100, 800 223 6925, 319-395 9626, fax, 319 395-0217	Robert Parsons, president	600	\$52	Intuit Inc. (1983)	Public	\$289
50	SPSS Inc. (now owns Systat Inc.)	444 N. Michigan Ave., Chicago, IL 60611-3862, 800-543-6608, 800-841-0064	Jack Noonan, president and CEO	404	\$52	SPSS Inc. (1968)	Public	\$52
51	Great Plains Software Inc.	1701 38th St. SW, Fargo, ND 58103, 800 456-0025, 701 9261 0550, fax, 701 281 3328	Doug Burgum, president and CEO	500	\$50	Great Plains Software Inc. (1981)	Private	\$50
52	Scitor Corp. Business Solutions Group	333 Middlefield Rd., Menlo Park, CA 94025, 800-533 9876, 415-462-4200, fax, 415-462 4201	Terry Petrzalka, president	300	\$50	Scitor Corp. (1979)	Private	\$50
53	FrieNet Corp.	3565 Harbor Blvd., Costa Mesa, CA 92626 1420, 800 345 3638, 714 966 3400, fax, 714 966 3490	Ted Smith, president and CEO	940	\$49	FrieNet Corp. (1982)	Public	\$1 900
54	Informix Software Inc.	4100 Bohannon Dr., Menlo Park, CA 94025, 800-331-1783, 415-926-6300, fax, 415-926-6583	Philip White, president, chairman, and CEO	2 200	\$47	Informix Software Inc. (1980)	Public	\$469
55	Recognition International Inc. Software Division	1310 Chesapeake Terr., Sunnyvale, CA 94089, 800 999 5910, 408-743 4300, fax, 408 743 4460	Bob Vanourek, president	150	\$45	Recognition Inter- national Inc. (1961)	Public	\$219
56	The Learning Company	5493 Kaiser Dr., Fremont, CA 94555, 800-852 2255, 510-792-2101, fax, 510 792-9628	William Dinsmore III, president and CEO	200	\$45	The Learning Company (1980)	Public	\$45
57	McAfee (now owns Brightwork Development Corp.)	2710 Walsh Ave., Santa Clara, CA 95051, 408 988 3832, fax, 408 970 9727	Bill Larson, president and CEO	143	\$43	McAfee (1989)	Public	\$43
58	Compton's NewMedia Inc.	2320 Camino Vida Roble, Carlsbad, CA 92009-1504, 800-862-2206, 619-929-2500, fax, 619-929-2511	Jim Longson, president and CEO	130	\$43	The Tribune Co. (1847)	Public	\$2 150
59	Datastorm Technologies Inc.	P.O. Box 1471, 2401 Lemone Blvd., Columbia, MD 65205, 800-315 3282, 314 443 3282, fax, 314 875-0595	Bruce Barklelew, president, Tom Smith executive VP, and Stephen Monaco VP of marketing	265	\$43	Datastorm Technologies Inc. (1986)	Private	\$43
60	Macromedia Inc. (now owns Altsys Corp.)	600 Townsend St., #310 W., San Francisco, CA 94103, 800-326-2128, 415-252-2000, fax, 415-626-0554	John C. Colligan, president and CEO	232	\$42	Macromedia Inc. (1992)	Public	\$42
61	Progress Software Corp.	14 Oak Park, Bedford, MA 01730, 800-477 6473, 617-280-4000, fax, 617 280-4095	Joseph Alsop, president	1 000	\$42	Progress Software Corp. (1981)	Public	\$139
62	Insignia Solutions Inc.	1300 Charleston Rd., Mountain View, CA 94043-1331, 800 848 7677, 415-335-7100, fax, 415-335-7105	Robert P. Lee, chairman and CEO	200	\$39	Insignia Solutions Inc. (1986)	Private	\$39
63	Maxis Inc.	Two Theater Sq., #230, Orinda, CA 94563 3346, 800 336 2947, 510 254 9700, fax, 510 253-3736	Jeff Braun, CEO	140	\$37*	Maxis Inc. (1989)	Private	\$37*

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 February, 1995

GRAPHICS PRO TURBO PCI
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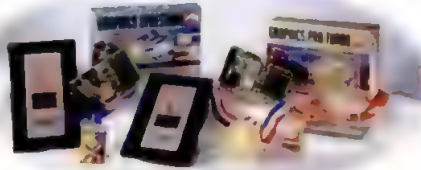


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THE PC MAGAZINE 200

Vendor Financial Information

Continues

Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	Worldwide PC software net revenues, 1994 (millions)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
PC SOFTWARE								
64	State Of The Art Inc. (now owns Menzania Inc.)	56 Technology Dr., Irvine, CA 92718; 800-854-3415, 714-753-1222; fax, 714-753-0930	David W. Hanna, president, chairman, and CEO	300	\$25	State Of The Art Inc. (1981)	Public	\$37
65	Best Programs Inc.	11413 Isaac Newton Sq., Reston, VA 22090; 800-368-2405, 703-709-5200; fax, 703-709-9359	James F. Petersen, chairman and CEO	125	\$35	Best Programs Inc. (1982)	Private	\$35
66	Activision Inc.	11801 Wilshire Blvd., 3d floor, Los Angeles, CA 90025; 310-473-9200; fax, 310-477-4102	Robert Kotick, chairman and CEO	150	\$34	Activision Inc. (1979)	Public	\$34
67	MapInfo Corp.	One Global View, Troy, NY 12180-8399; 800-327-8627, 518-285-6000; fax, 518-285-6070	Brian D. Owen, president and CEO	255	\$33	MapInfo Corp. (1986)	Public	\$33
68	Quarterdeck Corp.	150 Pico Blvd., Santa Monica, CA 90405; 800-354-2834, 310-392-9051; fax, 310-314-3219	Gaston Bastien, president and CEO	200	\$28	Quarterdeck Corp. (1982)	Public	\$28
69	Peachtree Software Inc.	1505 Pavilion Pl., Norcross, GA 30093; 800-247-3224, 404-584-5700; fax, 404-584-5888	J. William Goodhue III, president	225	\$28	Automatic Data Processing (1958)	Public	\$2,250
70	Stac Electronics	12838 High Bluff Dr., San Diego, CA 92130; 800-522-7822, 619-794-4333; fax, 619-794-4575	Gary Clow, president and CEO	204	\$26	Stac Electronics (1983)	Public	\$26
71	Traveling Software Inc.	18702 N. Creek Pkwy., Bothell, WA 98011; 800-343-8088, 206-483-8080; fax, 206-485-6786	Mark Eppley, CEO	120	\$25	Traveling Software (1982)	Private	\$25
72	ON Technology Corp.	One Cambridge Center, Cambridge, MA 02142; 800-767-6863, 617-374-1400; fax, 617-374-1433	Christopher A. Risley, president and CEO	200	\$25	ON Technology Corp. (1987)	Private	\$25
73	MECC (Minnesota Educational Computing Corp.)	6160 Summit Dr. N., Minneapolis, MN 55430-4003; 800-685-6322, 612-569-1500; fax, 612-569-1551	Dale LaFrenz, president and CEO	195	\$25	MECC (1973)	Public	\$25
74	Softdisk Inc.	7 Liberty Hill Rd., Henniker, NH 03242; 800-727-8371, 603-428-3199; fax, 603-428-7901	David C. Arnold, president and CEO	200	\$24	Softdisk Inc. (1985)	Public	\$24
75	Platinum Software Corp.	195 Technology Dr., Irvine, CA 92718-2402; 800-426-0469, 714-453-4000; fax, 714-453-4091	Carmelo J. Santoro, chairman and CEO	500	\$24	Platinum Software Corp. (1984)	Public	\$60
76	MathSoft Inc.	101 Main St., Cambridge, MA 02142-1521; 800-526-4223, 617-577-1017; fax, 617-577-8829	Chuck Digate, president and CEO	110	\$23 ^{††}	MathSoft Inc. (1984)	Public	\$23 ^{††}
77	PeopleSoft Inc.	4440 Rosewood Dr., Pleasanton, CA 95488-3031; 800-946-9460, 510-225-3000; fax, 510-225-3100	David Duffield, CEO	876	\$23	PeopleSoft Inc. (1987)	Public	\$113
78	Timberline Software Corp.	9800 SW Nimbus, Beaverton, OR 97214; 800-628-8583, 503-626-6775; fax, 503-626-9010	John Gorman, president	205	\$22	Timberline Software Corp. (1972)	Public	\$22
79	Easel Corp.	25 Corporate Dr., Burlington, MA 01803; 800-625-3287, 617-221-2100; fax, 617-221-3099	John McDonough, CEO	140	\$20	Easel Corp. (1981)	Public	\$20
80	Asymetrix Corp.	110 110th Ave. NE, #700, Bellevue, WA 98004; 800-448-9543, 206-482-0501; fax, 206-637-1504	Vern Raburn, acting president and CEO	250	\$20	Asymetrix Corp. (1985)	Private	\$20

* Revenues are for fiscal quarters 2/1/94-1/31/95 (fiscal year ended 7/31/94)

† Revenues are for fiscal quarters 1/1/94-12/31/94 (fiscal year ended 3/31/94)

** Revenues are for fiscal year 2/1/94-1/31/95

†† Revenues are for fiscal quarters 1/1/94-12/31/94 (fiscal year ended 7/31/94)

*** Revenues do not include figures for Powersoft Corp.

Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	Worldwide network hardware revenues, 1994 (millions)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
NETWORK HARDWARE								
1	IBM Corp., Networking Hardware Division	1133 Westchester Ave., White Plains, NY 10604; 914-842-6238, fax, 914-642-3595	B. J. Johnson, general manager	Info not available	\$3,100	IBM Corp. (1914)	Public	\$64,052
2	Bay Networks Inc.	4401 Great America Pkwy., P.O. Box 58185, 2 Santa Clara, CA 95054; 800-778-0885, 408-988-2400, fax, 408-988-5525	Andrew K. Ludwick, president and CEO	3,300	\$1,188	Bay Networks Inc. (1988)	Public	\$1,188
3	Cisco Systems Inc.	170 West Tasman Dr., San Jose, CA 95134; 800-553-6387, 408-526-4000, fax, 408-526-4100	John Chambers, president and CEO	2,262	\$855	Cisco Systems Inc. (1984)	Public	\$1,500
4	Cabletron Systems Inc.	35 Industrial Way, Rochester, NH 03867-0505; 800-332-9401, 603-337-1118; fax, 603-332-4004	S. Robert Levine, president and CEO	4,870	\$522	Cabletron Systems Inc. (1983)	Public	\$773
5	3Com Corp.	5400 Bayfront Plaza, Santa Clara, CA 95052-8145; 800-638-3266, 408-764-5000, fax, 408-764-5001	Eric A. Benhamou, president and CEO	1,697	\$486	3Com Corp. (1979)	Public	\$1,014
6	Digital Equipment Corp., Network Product Business	550 King St., Littleton, MA 01460; 800-457-8211, 508-682-2562; fax, 508-302-0003	Laurence Walker, vice president and general manager	2,100	\$395	Digital Equipment Corp. (1957)	Public	\$13,400
7	National Semiconductor Corp., LAN Division	2900 Semiconductor Dr., Santa Clara, CA 95052; 800-272-9959, 408-721-5000	Doug McBurnie, vice president and general manager	1,250	\$310	National Semiconductor Corp. (1959)	Public	\$2,300
8	Standard Microsystems Corp. (SMC)	80 Arkay Dr., Hauppauge, NY 11786; 800-762-4968, 516-435-6256; fax, 516-273-1803	Victor F. Trizzino, president and CEO	784	\$270	Standard Micro- systems Corp. (1971)	Public	\$370
9	Hewlett-Packard Co., Rooseville Networks Division	9000 Foothills Blvd., Roseville, CA 95747; 800-533-1333, fax, 800-333-1917	Gary McNally, general manager	3,000	\$210	Hewlett-Packard Co. (1939)	Public	\$26,613

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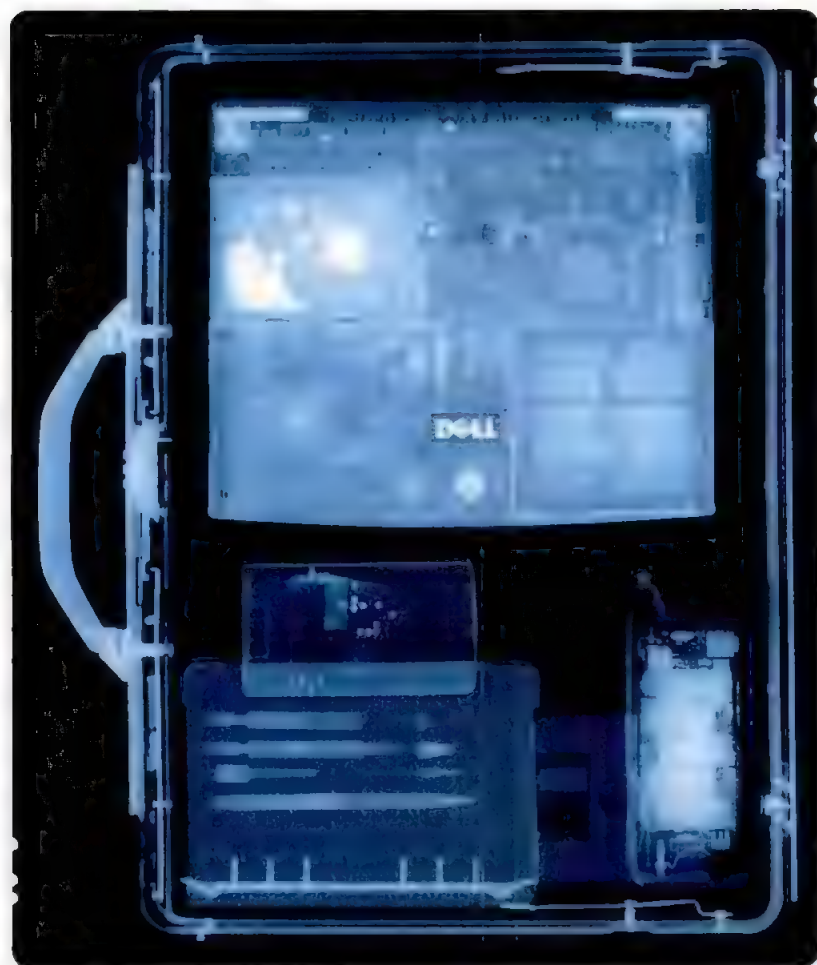
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Vendor Financial Information

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Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	Worldwide network hardware revenues, 1994 (millions)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
NETWORK HARDWARE								
10	Network Equipment Technologies Inc.	800 Saginaw Dr., Redwood City, CA 94063; 800-368-4838, 415-368-4400; fax, 415-368-5875	Joseph J. Francesconi, president and CEO	1,100	\$183	Network Equipment Technologies Inc. (1983)	Public	\$269
11	Newbridge Networks Inc.	593 Herndon Pkwy., Herndon, VA 22070; 800-343-3600, 703-834-3600, fax, 703-471-7080	F. Michael Pascoe, president (Newbridge U.S.)	600	\$181	Newbridge Networks Corp. (1986)	Public	\$205
12	UB Networks Inc.	3890 Freedom Circle, Santa Clara, CA 95054; 800-777-4528, 408-408-0111; fax, 408-970-7337	Ruel Proper, president and CEO	727	\$180	Tandem Computers Inc. (1976)	Public	\$2,108
13	U.S. Robotics Corp.	8100 N. McCormick Blvd., Skokie, IL 60076-2999; 800-877-2677, 708-982-5010; fax, 708-933-5800	Casey Cowell, president and CEO	1,290	\$149	U.S. Robotics Corp. (1976)	Public	\$378
14	Chippcom Corp.	118 Turnpike Rd., Southborough, MA 01772; 800-228-9830, 508-480-8800; fax, 508-480-8850	Rob Held, president and CEO	700	\$146	Chippcom Corp. (1983)	Public	\$268
15	Madge Networks Inc.	2310 N. First St., San Jose, CA 95131-1011; 800-878-2343, 408-955-0700, fax, 408-955-0970	R. H. Madge, chairman and CEO	208	\$140	Madge N.V. (1993)	Public	\$213
16	Xircorn Inc.	2300 Corporate Center Dr., Thousand Oaks, CA 91320; 800-874-7875, 805-378-9300; fax, 805-378-9311	Dirk I. Gates, president and CEO	331	\$132	Xircorn Inc. (1988)	Public	\$132
17	Network Systems Corp.	7600 Boone Ave. N., Minneapolis, MN 55428-4866; 800-338-0122, 612-424-4888, fax, 612-424-2853	Lyle D. Altman, president and CEO	1,100	\$126	Storage Technology Corp. (1969)	Public	\$1,705
18	Rockwell International Corp., Network Systems Division	7402 Hollister Ave., Santa Barbara, CA 93117; 800-282-8023, 805-968-4262; fax, 805-968-8478	Nick Whelan, business director	100	\$105	Rockwell International Corp. (1987)	Public	\$11,123
19	Artisoft Inc.	2202 Forbes Blvd., Tucson, AZ 85745; 800-233-5564, 520-670-7100, fax, 520-670-7101	Kathryn Hughes, director, product management	525	\$100	Artisoft Inc. (1982)	Public	\$121
20	Xyplex Inc.	235 Foster St., Littleton, MA 01460-9302; 800-338-5318, 508-952-4700; fax, 508-952-4702	Peter Neabada, president and CEO	581	\$98	Raytheon (1981)	Public	\$98
21	Proton Inc.	9 Technology Dr., Westborough, MA 01581-1799; 800-545-7464, 508-898-2800, fax, 508-366-8901	Daniel J. Capone, Jr., president and CEO	300	\$94	Proton Inc. (1974)	Public	\$94
22	Gandalf Systems Inc.	501 Delcan Pkwy., Delran, NJ 08075; 800-426-3253, 609-461-8100; fax, 609-461-4074	Paul Beaumont, vice president, sales, service, and marketing (the Americas)	300	\$91	Gandalf Technologies (1970)	Public	\$131
23	Optical Data Systems	1101 E. Arapaho Rd., Richardson, TX 75081-2336; 214-234-6400, fax, 214-234-1467	G. Ward Paxton, president and CEO	245	\$85	Optical Data Systems (1983)	Public	\$85
24	Asanté Technologies Inc.	821 Fox Ln., San Jose, CA 95131; 800-862-9688, 408-435-8388; fax, 408-432-7511	Jeff Lin, president and CEO	180	\$80	Asanté Technologies (1988)	Public	\$80
25	Attachmate Corp.	3617 131st Ave. SE, Bellevue, WA 98006-1332; 800-426-6283, 206-644-4010; fax, 206-747-9924	Jim Lindner, president and COO	825	\$80	Attachmate Corp. (1982)	Private	\$391

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PRINTERS									
1	Hewlett-Packard Co., Inkjet Products Group Hewlett-Packard Co., LaserJet Printer Group	16399 W. Bernardo Dr., San Diego, CA 92127; 619-487-4100 11311 Chinden Blvd., Boise, ID 83714; 208-396-1000	Antonio Perez, manager Carolyn Ticknor, general manager	Info not available Info not available	\$1,500 \$3,300	3,950 2,160	Hewlett-Packard Co. (1939) Hewlett-Packard Co. (1939)	Public Public	\$26,613 \$26,613
2	Epson America Inc.	20770 Madrone Ave., Torrance, CA 90503; 800-289-3778; 310-782-0770; fax, 310-782-4455	Norio Niwa, president and CEO	700	\$705	1,200	Seiko Epson Corp. (1942)	Private	\$4,500
3	Apple Computer Inc., Worldwide Imaging Product Marketing	1 Infinite Loop, Cupertino, CA 95014; 800-538-9696, 408-961-1010	Terry Bailey, senior director for Apple Printer Products	Info not available	\$827	752	Apple Computer Inc. (1977)	Public	\$9,500
4	Canon Computer Systems Inc.	2995 Redhill Ave., Costa Mesa, CA 92626; 800-848-4123, 714-438-3391; fax, 714-438-3317	Yasuhiro Tsubota, president and CEO	300	\$683	1,200	Canon Inc. (1937)	Public	\$19,300
5	Okidata	532 Fellowship Rd., Mount Laurel, NJ 08054; 800-854-3282, 609-235-2600, fax, 609-778-4184	Dennis P. Flanagan, president and CEO	700	\$518	616	Ok Electric Industry Co. Ltd. (1981)	Public	\$6,300
6	Lexmark International Inc.	55 Railroad Ave., Greenwich, CT 06836; 800-358-5835, 806-237-2000; 806-232-2380	Marvin L. Mann, chairman and CEO	4,300	\$337	286	Lexmark International Inc. (1991)	Private	\$1,800
7	Panasonic Communications & Systems Co.	Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000	Steve Yuhas, president	500	\$253	902	Matsushita Electric Industrial Co. Ltd. (1918)	Public	\$64,300

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THE PC MAGAZINE 200

Vendor Financial Information

Continues

Rank	Company (or division)	Address, telephone, fax	Head of company (or division)	Number of employees (U.S.)	U.S. revenues, 1994 (millions)	Units sold in U.S., 1994 (thousands)	Parent company (and year founded)	Ownership of parent company	Parent company's net revenues, 1994 (millions)
PRINTERS									
8	Brother International Corp.	200 Cottontail Ln., Somerset, NJ 08875; 800-276-7748, 908-356-8880	Hiroshi Gunji, president and CEO	38	\$88	159	Brother International Corp. (1964)	Private	\$700
9	Citizen America Corp.	2450 Broadway #600, Santa Monica, CA 90411-4003; 800-477-4683, 310-453-0614; fax, 310-453-2814	Hiroshi Takahashi, president	100	\$67	286	Citizen Watch Co. Ltd. (1930)	Private	\$4,120
10	Texas Instruments Inc.	5701 Airport Rd., Temple, TX 76703; 800-848-3527, 817-771-5858; fax, 817-774-8660	Pallab Chatterjee, president	2,500	\$50	118	Texas Instruments Inc. (1930)	Public	\$10,315

MONITORS									
1	NEC Technologies Inc.	1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-632-4636, 508-264-8000; fax, 508-264-8673	Jim Schwabe, vice president	2,100	\$700	1,150	NEC Corp. (1899)	Public	\$35,000
2	Samsung Electronics America Inc.	105 Challenger Rd., Ridgefield Park, NJ 07860; 800-726-7864, 201-691-6200; fax, 201-347-8650	K. R. Song, president	800	\$305	1,499	Samsung Group (1938)	Public	\$64,000
	Samtron Displays Inc.	18600 Broadwick St., Rancho Dominguez, CA 90220; 800-726-8766, 310-537-7000; fax, 310-537-1033	K. W. Park, president	34	\$300	1,400	Samsung Group (1938)	Public	\$54,000
3	Philips Consumer Electronics Co.	One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-835-3508, 310-217-1300; fax, 310-217-1833	Robert Minkhorst, president and CEO	8,000	\$580	Info not available	Phillips Electronics NV Corp. (1969)	Public	\$34,000
4	Sony Electronics Inc.	3300 Zanker Rd., San Jose, CA 95134; 800-352-7669, 408-432-0190; fax, 408-995-5171	Yasuhiro Kuga, president	300	\$510	925	Sony Corp. (1948)	Public	\$38,000
5	LG Electronics U.S.A. Inc. (formerly Goldstar USA Inc.)	1000 Sylvan Ave., Englewood Cliffs, NJ 07632; 201-816-2000; fax, 201-818-0636	Nam K. Woo, president	144	\$408	2,160	LG Electronics Inc. (1958)	Public	\$35,000
6	CTX International Inc.	20530 Earlgate St., Walnut, CA 91789; 800-888-9052, 909-595-6146; fax, 909-595-6293	Y.C. Liu, president	160	\$312	1,100	Chuntex Electronic Co Ltd (1981)	Public	\$377
7	Tatung Co. of America Inc.	2850 El Presidio St., Long Beach, CA 90810; 800-829-2850, 310-637-2105; fax, 310-637-8484	Hsi-Chin Liu, president	200	\$280	1,500	Tatung Co. (1918)	Private	\$3,500
8	MAG InnoVision Inc.	2801 S. Yale St., Santa Ana, CA 92704; 800-827-3998, 714-751-2008; fax, 714-751-5522	William Wang, president	100	\$272	886	MAG InnoVision Inc. (1987)	Private	\$275
9	ADI Systems Inc.	2115 Ringwood Ave., San Jose, CA 95131; 800-228-0330, 408-944-0100; fax, 408-944-1300	Raymond Hou, president	60	\$260	880	ADI Corp. (1979)	Public	\$475
10	Mitsubishi Electronics America Inc.	5665 Plaza Dr., P.O. Box 6007, Cypress, CA 90630-0007; 800-843-2515, 714-236-5000; fax, 800-937-2094	Takeo Linuma, chairman and CEO	1,100	\$243	365	Mitsubishi Electric Corp. of Japan (1921)	Public	\$38,000

HARD DISKS									
1	Seagate Technology Inc.	920 Disc Dr., Scotts Valley, CA 95066; 408-438-8111; fax, 408-438-7852	Alan F. Shugart, president, chairman, and CEO	58,106	\$2,192	7,139	Seagate Technology Inc. (1979)	Public	\$3,970
2	IBM Storage Products Co., IBM Storage Systems Division	5600 Cottle Rd., San Jose, CA 95193; 800-428-3333, 408-256-8000	Ray Abu Zayyad, general manager	Info not available	\$1,456	4,134	IBM Corp. (1914)	Public	\$64,052
3	Quantum Corp.	500 McCarthy Blvd., Milpitas, CA 95035; 800-624-5545, 408-894-4000; fax, 408-894-3218	William J. Miller, chairman and CEO	7,000	\$1,431	7,592	Quantum Corp. (1980)	Public	\$3,500
4	Conner Peripherals Inc.	3081 Zanker Rd., San Jose, CA 95134-2128; 800-428-6637, 408-458-4500; fax, 408-458-4501	Finis F. Conner, chairman and CEO	11,000	\$1,340	6,187	Conner Peripherals Inc. (1986)	Public	\$2,400
5	Western Digital Corp.	8105 Irvine Center Dr., Irvine, CA 92718; 800-832-4778, 714-932-4900; fax, 714-932-6498	Charles A. Haggerty, president, chairman, and CEO	6,900	\$1,108	5,173	Western Digital Corp. (1970)	Public	\$1,900
6	Hewlett-Packard Co., Information Storage Group	P.O. Box 15, Boise, ID 83707-0015; 208-396-6000	Bruce F. Spenser, general manager	Info not available	\$521	510	Hewlett-Packard Co. (1939)	Public	\$26,613
7	Maxtor Corp.	211 River Oaks Pkwy., San Jose, CA 95134; 800-462-9667, 408-432-1700; fax, 408-922-2085	C.S. Park, president and CEO	6,200	\$500	2,675	Maxtor Corp. (1982)	Public	\$892
8	Fujitsu Computer Products of America Inc.	2904 Orchard Pkwy., San Jose, CA 95134-2008; 800-626-4666, 408-432-6333; fax, 408-894-1706	Dennis Hill, general manager	800	\$344	414	Fujitsu Ltd. (1935)	Public	\$30,000
9	Toshiba America Information Systems Inc., Disk Products Division	9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-563-3000; fax, 714-567-6424	Frank Buckley, vice president and general manager	1,467	\$264	1,056	Toshiba Corp. (1875)	Public	\$42,900
10	Micropolis Corp.	21211 Nordhoff St., Chatsworth, CA 91311; 800-395-3748, 818-709-3300; fax, 818-709-3487	Stuart P. Mabon, president and CEO	2,200	\$218	230	Micropolis Corp. (1978)	Public	\$348



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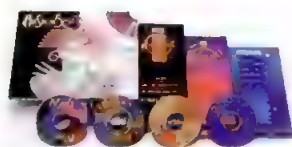
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THE PC MAGAZINE 200

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CD-ROM DRIVES									
1	Panasonic Communications & Systems Co.	2 Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000	Steve Yuhas, president	500	\$504	4,800	Matsushita Electric Industrial Co. Ltd. (1918)	Public	\$64,300
2	Sony Electronics Inc.	3300 Zanker Rd., San Jose, CA 95134; 800-352-7669, 408-432-0190; fax, 408-995-5171	Yasuhiro Kuga, president	300	\$187	1,700	Sony Corp. (1948)	Public	\$38,000
3	NEC Technologies Inc.	1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-632-4636, 608-284-8000; fax, 508-264-8673	Kenjiro Nitta, chairman and CEO	2,100	\$155	1,030	NEC Corp. (1899)	Public	\$35,000
4	Toshiba America Information Systems Inc., Disk Products Division	9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-587-6424	Frank Buckley, vice president and general manager	1,467	\$105	700	Toshiba Corp. (1875)	Public	\$42,900
5	Mitsumi Electronics Corp.	6210 N. Beltline Rd. #170, Irving, TX 75063; 800-648-7864, 214-550-7300; fax, 214-550-7424	T. Kumagai, vice president	60	\$63	650	Mitsumi Electronics Co. (1954)	Public	\$2,200

GRAPHICS/VIDEO BOARDS									
1	Diamond Multimedia Systems Inc.	2880 Junction Ave., San Jose, CA 95134-1922; 800-468-5848, 408-325-7000; fax, 408-325-7411	Bill Schroeder, president and CEO	200	\$128	756	Diamond Multimedia Systems Inc. (1982)	Private	\$203
2	ATI Technologies Inc.	33 Commerce Valley Dr. E., Thornhill, Ontario, Canada L3T 7N6; 905-882-2626; fax, 905-882-2620	K.Y. Ho, president and CEO	600	\$98	750	ATI Technologies Inc. (1985)	Public	\$151
3	STB Systems Inc.	1651 N. Glenview, #210, Richardson, TX 75085-0957; 800-234-4334, 214-234-8750; fax, 214-234-1306	William B. Ogle, chairman and CEO	145	\$79	769	STB Systems Inc. (1981)	Private	\$96
4	Number Nine Visual Technology Corp.	18 Hartwell Ave., Lexington, MA 02173; 800-438-6463, 617-674-0008; fax, 617-674-2819	Andy Najda, president and CEO	88	\$47 [†]	2,251	Number Nine Visual Technology Corp. (1982)	Private	\$66
5	Matrox Graphics Inc.	1055 St. Regis Blvd., Dorval, Quebec, Canada H9P 2T4; 800-361-1408; fax, 514-685-2853	Lorne Trotter, president	125	\$30	600	Matrox Electronic Systems Ltd. (1978)	Private	\$125

[†] Based on units sold within North America.

SOUND BOARDS									
1	Creative Labs Inc.	1901 McCarthy Blvd., Milpitas, CA 95035; 408-428-6600; fax, 408-428-2394	Sim Wong Hoo, CEO	1,000	\$550	6,000	Creative Technology Ltd. (1983)	Public	\$1,013
2	Aztech Labs Inc.	46707 Fremont Blvd., Fremont, CA 94538; 800-886-8829, 510-623-8988; fax, 510-623-8989	Michael Mun, president	40	\$136	1,890	Aztech Systems Ltd. (1986)	Public	\$248
3	Media Vision Technology Inc.	47900 Bayside Pkwy., Fremont, CA 94538; 510-770-8600; fax, 510-770-8648	G. Robert Brownell, president and CEO	260	\$75	870	Media Vision Technology Inc. (1990)	Public	\$147
4	Diamond Multimedia Systems Inc.	2880 Junction Ave., San Jose, CA 95134-1922; 800-468-5848, 408-325-7000; fax, 408-325-7411	Bill Schroeder, president and CEO	200	\$8	100	Diamond Multimedia Systems Inc. (1982)	Private	\$203
(tie)	Turtle Beach Systems Inc.	52 Grumbacher Rd., York, PA 17402; 800-645-5640, 717-767-0200; fax, 717-767-8033	Marty Goldberg, vice president and general manager	60	\$8	60	Integrated Circuit Systems Inc. (1976)	Public	\$94

METHODOLOGY

In March 1995 we faxed a multiple-item questionnaire to more than 700 companies, requesting financial details about each. We asked for current address, head of company, total number of employees, total revenues for the product division, number of units sold, and parent-company revenues. We sent faxes to the companies based on their appearance in *PC Magazine* reviews during the last 18 months, as well as their presence in our 1994 chart (*PC Magazine*, July 1994). We also compiled lists from other sources, including market research firms, analysts, and industry- and business-oriented publications.

We looked at total revenues from a specific product line for each company, or each division in the case of IBM, Apple, and other large, diversified companies. These lines included PCs, software, network hardware, printers, monitors, hard disks, CD-ROM drives, graphics/video boards, and sound boards. To assure comparability, we not only specified revenues for the product category, we also requested 1994 calendar-year sales figures (to eliminate variances of corporate fiscal years beginning and ending in different months). We also asked for information about the parent company of each U.S. company or division. For graphics/video boards, we ranked the largest North American companies, because ATI and Matrox, two Canadian companies, have such large shares of the U.S. market.

When companies chose not to participate (because they were privately held or because they could not produce the numbers with the breakdowns we asked for), we turned to outside analysts for assistance. The sources we used included: Aberdeen Group Inc.; BIS Strategic Decisions; Computer Intelligence InfoCorp (our primary source for PC revenues); *CorpTech Directory of Technology Companies*; Dataquest Inc.; *Dayton Daily News* (April 18, 1995); *Directory of Corporate Affiliations*; *Dun & Bradstreet Million Dollar Directory*; *America's Leading Public & Private Companies*; Information Access Co.; International Data Corp.; Morgan Stanley Equity Research; *Softletter*; *Standard & Poor's Register of Corporations, Directors and Executives*; Stanford Resources; and *The Wall Street Journal* (July 28, 1994).

If these sources could not supply answers (often because they focus on worldwide revenues of parent companies and not breakdowns by division), we did some interpolation based on the reported percent of the revenues that could be attributed to the PC portion of a company's business. In the case of software vendors, we interpolated estimated net revenues of those companies whose PC software revenues were less than 50 percent of their overall revenues. Whenever we interpolated data, we gave the vendor opportunity to respond to our figures and provide alternatives.

Our Contributors: ROBIN RASKIN is the editor of *PC Magazine*. BRAD STILWELL and JODI L. WYNBLATT are senior editorial researchers and YVONNE KOULOUTHROS and GREGORY SEWELL are editorial researchers at *PC Magazine*. They compiled the data for the *PC Magazine 200*.

User-to-User

BY NEIL J. RUBENKING

Tuning Memory Paging in Windows

Here's a tip that may help users who work in several applications at the same time reduce Windows' excessive paging to the swap file.

My laptop has 8MB of memory, which should be enough to run several Windows applications simultaneously. As with most laptops, the hard disk is not as fast as its desktop counterparts. I noticed that when I had several applications open, the system seemed to access the hard disk constantly. In some cases, especially when working with large applications such as WordPerfect or Quattro Pro, the system would be hung up for half a minute or longer just doing disk accesses. This was puzzling, because the SYSTEM application showed I still had over 60 percent of memory free, and even my other resources (USER, GDI, and so on) showed at least 40 percent free. I also noticed that even after the application completed my request (opening a document, for example), the disk accesses would continue for some time while the system was waiting for more input from me. I began researching the function of the paging controls available in SYSTEM.INI and discovered two settings that provided dramatic relief. The settings are LRURateChngTime and LRUSweepReset.

LRURateChngTime sets the amount

of time Windows pages at a high rate and then at the low rate, and when to stop paging. LRUSweepReset seems to control how often the pages are marked as having been referenced. The default for LRURateChngTime is 10,000 milliseconds, and the default for LRUSweepReset is 500 (the number is used in a subsequent calculation based upon the amount of memory in the machine to arrive at a final value). I changed LRURateChngTime to 750 milliseconds and changed the value of LRUSweepReset to 100. This dramatically reduced the amount of time Windows spent accessing the hard disk when multiple applications were active.

I now receive acceptable response time until my free resources drop below 30 percent. As far as I can tell, there are no adverse side effects. I believe that the more important of the two settings is the LRURateChngTime, which governs the amount of time Windows spends paging once a page fault occurs. The other set-

ting seemed to help to some extent but did not have as dramatic an effect as changing LRURateChngTime.

I am at a loss to explain why the designers would have Windows page for any amount of time longer than absolutely necessary once all existing page-fault conditions have been serviced. This seems to cause needless disk accesses. My background is in IBM-mainframe systems programming, and in that environment paging only takes place when a current shortage of memory exists.

Scott Ward
Cincinnati, Ohio

► **PC MAGAZINE:** "LRU" in the names of these two .INI file keys stands for "least recently used." This describes the method used by Windows' Virtual Memory Manager (VMM) to decide which pages of memory to swap out. For each page, the VMM keeps an Accessed flag and a Dirty flag. The Accessed flag is set when the page is read from or written to; the Dirty flag means the page has been written to. When a program's request for memory can't be satisfied using actual RAM, the VMM goes through several steps in deciding which pages to swap out to disk:

- It sweeps through the table of pages looking for any that aren't flagged as either Accessed or Dirty. At the same time, it clears the Accessed flags.
- If enough nonflagged pages were found by the first sweep, it swaps those pages to disk and uses the free memory thus created to satisfy the program's request.
- Otherwise, the VMM sweeps through the table of pages again. Since the first sweep cleared all the Accessed flags, the second sweep may find enough nonflagged pages to satisfy the request.
- If the second sweep doesn't find enough nonflagged pages, the VMM swaps pages to disk regardless of their flags.

LRURateChngTime and LRUSweepReset, along with four other keys in SYSTEM.INI's [386Enhanced] section, con-

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trol this process. The LRU sweep process begins when the number of free pages drops below the value specified by `LRUSweepLowWater` (default: 24 pages). Each sweep checks the number of pages specified in `LRUSweepLen` (default: 1,024 pages). At first the sweeps occur at a high rate, separated by the number of milliseconds in `LRUSweepFreq` (default: 250 milliseconds). After the time specified in `LRURateChngTime` (default: 10,000 milliseconds), the VMM switches to a low rate. The time between sweeps at the low rate is the high rate time multiplied by `LRULowRateMult`. After the `LRURateChngTime` interval passes at the low rate, the LRU sweep is turned off. Finally, the `LRUSweepReset` value (default: 500 milliseconds) is related to the time spent clearing the Accessed flags. Unfortunately, neither the Windows Resource Kit nor the Microsoft Developers Network CD clearly defines the precise purpose of `LRUSweepReset`.

Thus the proposed changes cause the LRU sweep process to switch from high rate to low and from low rate to off in 0.75 seconds rather than 10 seconds and (apparently) to clear the Accessed bits five times as frequently. The Windows Resource Kit descriptions of these keys all have the note "(You should never need to change this entry)" appended, but as this reader has noted, you may be able to increase efficiency by tweaking them. Just be sure to record the original values before making any changes.

A Better Choice

Your item on the CHOICE command in the December 20, 1994, issue didn't mention that CHOICE contains a serious bug: Any character following a "/" (forward slash) in the text is interpreted as a switch for the CHOICE command itself, rather than as part of the text. Thus, the batch file

```
CHOICE /N /T:N,5 Run
CHKDSK /F (y or n)?
IF ERRORLEVEL 2 GOTO :EXIT
IF ERRORLEVEL 1 CHKDSK /F
:EXIT
```

generates the message "Invalid switch on command line." If /F is omitted following CHKDSK, the program runs fine. This bug virtually eliminates the usefulness of the command, since you'd most likely use it to run programs, and many programs need command switches to run properly.

Mike Bruss
via ZiffNet

► **PC MAGAZINE:** Never fear! The CHOICE command is just as useful as ever, provided you know how to work with it. Yes, any character following a forward slash in the prompt text for the CHOICE command will be interpreted as a command-line switch. If it's not a valid switch for CHOICE, you'll get the "Invalid switch. . ." message. A valid switch accidentally introduced this way may be even worse, as it will simply take effect without warning.

The solution is simple: Put the entire prompt text in quotes, like so:

```
CHOICE /N /T:N,5 "Run CHKDSK
/F (y or n)?"
```

This line performs as expected. Quotes are needed only when the prompt text contains a forward slash, but since they're harmless, it's a good idea to get into the habit of using them around the prompt text of any CHOICE command.

Note that the quotes used in the prompt text must surround the entire text. If you want to put quotes in the prompt text, just ECHO the text and follow it with a CHOICE line that has no prompt:

```
ECHO Run "CHKDSK /F" (y or n)?
CHOICE /N /T:N,5
```

The only difference in output is that the input character appears on the next line, rather than on the same line as the prompt.

Making DIR More Efficient

Here's a line you can add to your AUTOEXEC.BAT to make your computing life a little easier:

```
SET DIRCMD=/P/O:GNE
```

With this option in effect, you'll notice that when you type DIR, the listing automatically pauses after a full screen. The list is also better organized. Directories are listed first, sorted in alphabetical order, followed by files in alphabetical order. And in instances where you have multiple occurrences of a file (as AUTOEXEC.BAT, AUTOEXEC.001, AUTOEXEC.BAK), these are further sorted by extension.

This one little statement can make finding files much easier.

Chris D. Smith
via ZiffNet

► **PC MAGAZINE:** In DOS 5.0 and later, you can specify any of the DIR command line switches in the DIRCMD environment variable, and these switches become the default. Command line switches can still override the DIRCMD defaults, of course. For example, if you set DIRCMD as suggested here and then enter DIR /OD, you'll get a directory listing organized by date. If you enter DIR /-P, you'll get a directory listing sorted as described above that does not pause after each page of information.

Batch file writers, you need to beware of DIRCMD! If your batch file processes output from DIR, it's not safe to make any assumptions about that output. You can't assume it will be uppercase, for example, and it may well require one or more keystrokes to finish if the /P switch is in DIRCMD. You have two choices. You can store the contents of DIRCMD, clear DIRCMD, perform your DIR command, and restore DIRCMD:

```
SET DIRTMP=%DIRCMD%
SET DIRCMD=
DIR [parameters]
SET DIRCMD=%DIRTMP%
SET DIRTMP=
```

It may be easier, though, simply to specify a precise value for each DIR switch, for example:

```
DIR /-P /-W /A:-H-S /O /-S /-B /-L /-C
```

More and more users are finding out just how convenient DIRCMD is, so batch file writers need to program defensively! □

Tutor

BY JEFF PROSISE

Cool Reading for a Hot Summer Day

Summertime is upon us, and as the mercury rises, thoughts naturally turn from the steamy outdoors to the air-conditioned confines of an office, home, or vacation condo. When it's too hot to venture outside, what better way to beat the heat than curling up with a good computer book?

As a computer user, I'm continually prowling the bookstores for the latest titles. Not just any titles, only those that are thoughtfully and authoritatively written and that say something that hasn't been said before. If trade magazines are the first line of defense against becoming antiquated in this fast-moving industry, then books are the heavy artillery. Reading trade magazines is probably the best way to stay abreast of the latest developments and emerging technologies, but magazines usually don't have the space for the detailed technical background that books can provide. And the sheer number of computer books available means that you must be selective about what you read.

To help you pick the wheat from the chaff, I've compiled a list of top-notch computer books on subjects ranging from Windows to general-interest computing. I've purposely avoided DOS books, in part because DOS is rapidly becoming a relic and also to avoid apparent conflicts of interest since I've written a couple of DOS books myself. I've also steered clear of tutorial-type works such as *DOS for Dummies* and *Running Windows 3.1* in favor of more technical books designed to bolster the foundation of one's understanding. Although I've undoubtedly omitted many titles that deserve mention, I think you'll find that the books discussed here represent the cream of the crop in

computer literature, and that each is a classic work in its own right.

WINDOWS Do you really want to understand Windows? Not just on a superficial level, but in a way that will truly make you stand out among your peers? If so, then pick up a copy of Charles Petzold's *Programming Windows* (1992, Microsoft Press), the seminal book that has taught a generation of programmers how to make Windows do the amazing things it does. Yes, *Programming Windows* is aimed at developers venturing into Windows for the first time. But it's a great book for technically minded end users and MIS managers too. Reading through it will teach you about some of the most fundamental aspects of Windows, from the message-based architecture to cooperative multitasking to what DLLs are and how they work. A big part of the book is the numerous sample programs written in C, but you can read around the source code listings and still profit handsomely. Of course, if you understand C, you'll profit even more.

If it's Windows 95 that interests you the most, put Adrian King's *Inside Windows 95* (1994, Microsoft Press) at the top of your reading list. In ten chapters, King provides a highly readable overview of the hottest topics in Windows 95, including the base architecture, the user interface, the VFAT file system, networking, and, of course, Plug and Play. Among other things, you'll learn how the Win-

dows 95 architects addressed some of Windows 3.1's most glaring deficiencies (such as resource limitations) while retaining a very high degree of compatibility with 16-bit DOS and Windows applications. Chapter 4 describes the division of labor between 16- and 32-bit code in the Windows 95 kernel, a hot topic among operating-system purists debating whether Windows 95 qualifies as a 32-bit operating system. It also describes the much-talked-about Win16Mutex, which sometimes locks 32-bit applications out of the kernel when 16-bit applications are executing.

Right after you finish *Inside Windows 95*, check out Andrew Schulman's *Unauthorized Windows 95* (1994, IDG Books). This work is something of a rebuttal to King's book, exploring the seamier side of Windows 95 and exposing exactly where and how it still relies on 16-bit code inherited from DOS and Windows 3.1. It's also loaded with historical insights into the evolution of Windows from a DOS add-on to a full-blown operating system. You may want to pass on this one if terms like V86 mode and selector scare you, but

I think you'll find that these books represent the cream of the crop in computer literature, and that each is a classic work in its own right.

overall Schulman does an excellent job of explaining his subject matter and making sure no one gets left behind. Schulman has been a thorn in Microsoft's side ever since he brought to light the so-called AARD code that caused Windows 3.1 betas to spout spurious warnings to DR-DOS users. *Unautho-*

Unauthorized Windows 95 won't do anything to better the relationship.

Helen Custer's *Inside Windows NT* (1993, Microsoft Press) is to Windows NT as King's *Inside Windows 95* is to Windows 95. For students of Windows NT, it's not to be missed. As a member of the NT development team, Ms. Custer was witness to the development of Windows NT and had access that few others enjoy. In *Inside Windows NT*, she uses her enviable writing skills to chronicle both the architecture of Windows NT and the design philosophies behind it.

Custer's recently published follow-up

to that book, *Inside the Windows NT File System* (1994, Microsoft Press), lays bare the details of the NTFS file system. You'll find answers to frequently asked questions like "Is it true that NTFS volumes are not subject to file fragmentation as DOS volumes are?" (It's clear from the book's descriptions of data structures and operation that NTFS volumes *can* become fragmented.) This is the book to own if you wish to understand NTFS.

OS/2 The OS/2 counterpart to *Inside Windows NT* is Harvey Deitel and M. Kogan's *The Design of OS/2* (1992, Addison-Wesley). After laying a foundation by reviewing the history of OS/2 and introducing the reader to microprocessor architectures, the authors discuss the architectural aspects of OS/2, including multitasking, processes and threads, memory management, dynamic linking, inter-process communication, installable file systems, and more. The level of detail presented in the book is typified by the following excerpt on process address spaces:

"The process virtual address space is implemented differently in the 16-bit and 32-bit versions of OS/2 because of their different memory models. The process virtual address space in 16-bit OS/2 is represented as a collection of segments mapped by a local descriptor table (LDT). The system switches LDTs when switching between processes. A process can access only memory that is mapped by its own LDT. In 32-bit OS/2, the process virtual address space is a single large segment (on the order of 512 MB) that represents a flat linear address space. Each process virtual address space is mapped by a per-process set of page tables."

Here we learn that OS/2 1.x uses a segmented address space in which processes are isolated from one another via separate LDTs. OS/2 2.0, by contrast, runs apps in unsegmented address spaces that are privatized by the processor's page tables. This kind of detail is hard to find even in operating-system architecture books.

The Design of OS/2 is the definitive work on OS/2 architecture. It covers OS/2 1.x as well as 2.0, but as of this writing it had not been updated for OS/2 3.0. It's also a good book to read if you're interested in operating-system design in general.

HARDWARE When it comes to understanding the inner workings of your hard-

ware, two books stand heads above the rest. *The Winn Rosch Hardware Bible* (1994, Brady), now in its third edition, provides a thorough overview of the various components and peripherals that make up a typical computer system. From video adapters to printers to serial ports, Rosch provides a firm technical background accompanied by descriptions of today's most common hardware designs. Ever wonder how a drive head records bits and bytes in a disk's magnetic surface? Or what all the wires in a hard disk interface cable are for? Rosch tells you how and why, while explaining many of the cryptic terms and acronyms encountered in other computer literature.

Hans-Peter Messmer's *The Indispensable PC Hardware Book* (1994, Addison-Wesley) goes Rosch one better when it comes to detail. The book's 985 pages cover a wide range of hardware topics, looking under the hood at such component devices as Intel, AMD, and Cyrix CPUs; memory-chip designs; and DMA controllers. This book has replaced many of the hardware technical references I've accumulated over the years. Look up interrupt controllers and Messmer not only describes what they do and how they work, he also documents the operation of the 8259A interrupt controller used in the original IBM PC (and still mimicked in today's PCs). And he includes highly detailed descriptions of the IDE and SCSI hard disk interfaces, information hard to find anywhere else. *The Indispensable PC Hardware Book* really is indispensable if you desire an all-in-one reference to the chips and devices that make up your PC.

Another hardware book that I've found to be an invaluable reference is Frank Van Gillsuwe's *The Undocumented PC* (1994, Addison-Wesley). This book is an encyclopedia of hard-to-find information regarding PC hardware designs. Among other things, it includes detailed descriptions of the various implementations of CMOS memory on ISA, EISA, and Micro Channel machines, and

demonstrates how to write a program that measures CPU clock speed.

Though not as well-known as some of the other books mentioned here, Milind S. Pandit's *How Computers Really Work* (1993, Osborne McGraw-Hill) is a real gem. In easy language that anyone can understand, Pandit explains how transistors work and then goes on to describe how transistors are combined to form logic gates, how logic gates are assembled to form simple mathematical circuits, and more. The title is a take-off on Ron

White's *How Computers Work* (1993, Ziff-Davis Press), but the two books are very different. Pandit approaches the subject at the circuit level, while White takes a higher-level approach that uses pictures, not text, as the primary means of communication. Both books are

as easily understandable to novices as they are to advanced computer users.

TECHNOLOGY If I had to pick the most important computer book to emerge in the past couple of years, my vote would probably go to *Inside the PowerPC Revolution* (1994, The Coriolis Group) by Jeff Dunte-mann and Ron Pronk. In addition to documenting the design and feature set of the PowerPC family of CPU chips, this book provides unparalleled historical insights into the microprocessor revolution and the rise of RISC CPUs. You don't have to be an electrical engineer to appreciate this book; it's written in a conversational style and it provides the best and most qualitative description I've seen of the difference between RISC and CISC CPU architectures. If you read only one computer book this summer, let this be the one.

Two of my favorite books on applied computer technology are *Applied Cryptography* (1994, John Wiley & Sons) by Bruce Schneier and *The Data Compression Book* (1992, M&T Publishing) by Mark Nelson. If you were intrigued by recent discussions of computerized data encryption in this column, you'll enjoy Schneier's book, which surveys just about every form of data encryption under the sun and presents highly detailed discus-

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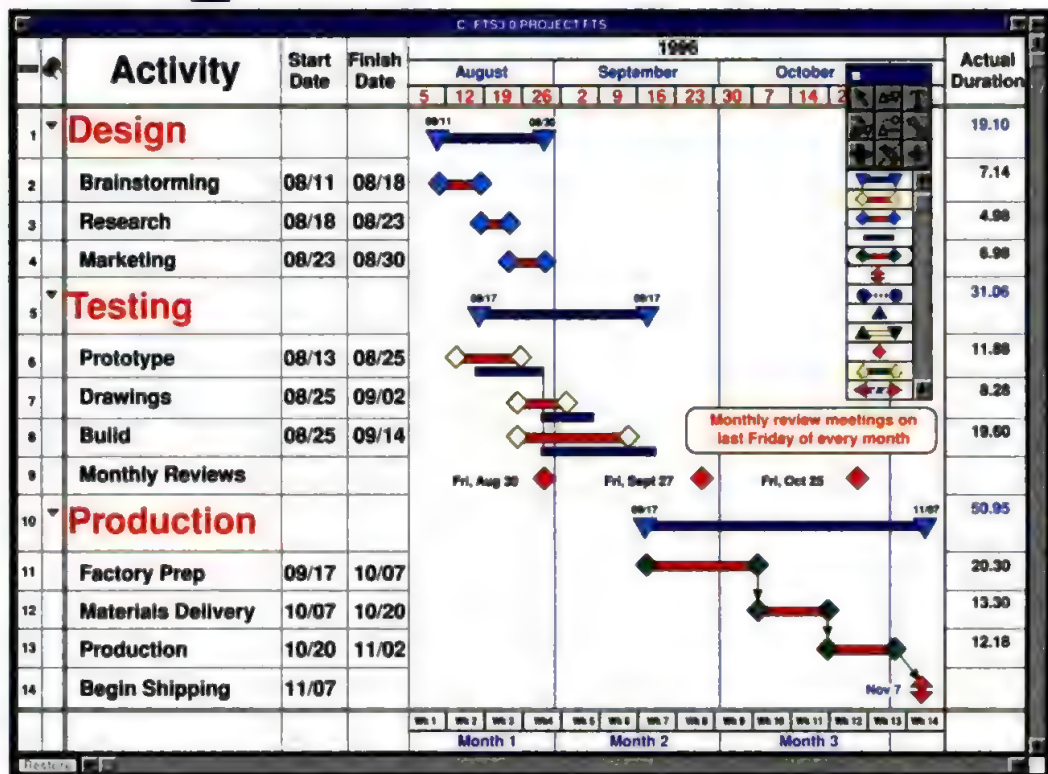


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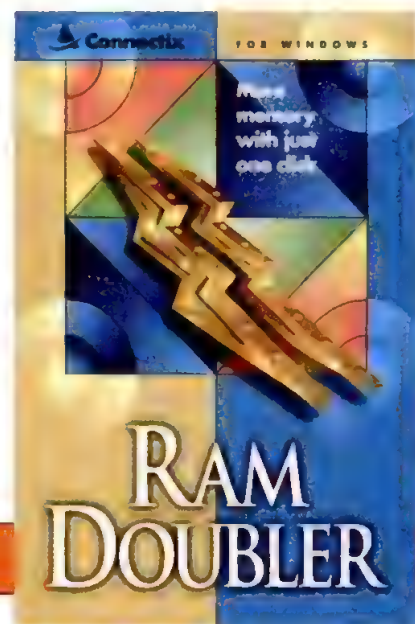
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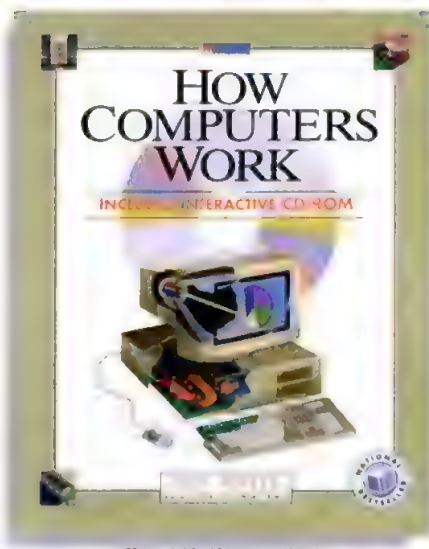


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sions of each method's theory and implementation. Nelson does for data compression what Schneier does for cryptography, explaining today's most commonly used compression algorithms with a blend of lucid prose and sample programs written in C. Nelson covers both lossless and lossy compression methods, so whether it's LZW or JPEG compression you're concerned about, you're likely to find it discussed in *The Data Compression Book*.

When it comes to computer graphics, the bible is—and has been for years—*Computer Graphics Principles and Practice* (1990, Addison-Wesley) by Foley, van Dam, Feiner, and Hughes. It's a compendium of information on nearly every subject pertinent to the theory of computer graphics, from line-drawing algorithms to hidden surface removal to 3-D modeling and rendering. A lesser-known but equally compelling work is Michael F. Barnsley and Lyman P. Hurd's *Fractal Image Compression* (1993, AK Peters), which explains the theory behind fractal image compression—the practice of compressing digitized images by reducing patterns of pixels to fractal equations describing affine transformations. Though filled with complex mathematics, this is the book to have if you wish to understand how fractal image compression works.

PROGRAMMING This isn't something that will interest everyone, but if you're a programmer looking for the right book to teach you C++, there is one that in my opinion has no equal. *Teach Yourself C++* (1995, MIS Press), by Al Stevens, methodically walks the reader through every feature of C++, explaining each new concept with just the right mixture of verbiage and sample code. Wording is accurate and concise, and the author is careful to avoid overwhelming the reader with unnecessary terms and phraseology. And after using this book as a learning tool, you'll find yourself referring to it again and again as you travel the road to becoming a competent C++ programmer.

GENERAL READING If you're looking for lighter and more novel fare, pick up a copy of *Gates* (1993, Doubleday), by *New York Times* columnist Stephen Manes and the *Seattle Times'* Paul Andrews. This is the definitive biography of Bill Gates, and it provides captivating reading from start to finish. More than just a biography, *Gates*

chronicles the evolution of Microsoft from its humble beginnings in the mid-1970s to its present-day status as software behemoth. It includes heretofore unpublished accounts of Microsoft's behind-the-scenes dealings with IBM and the development of such imposing products as DOS, OS/2, and Windows.

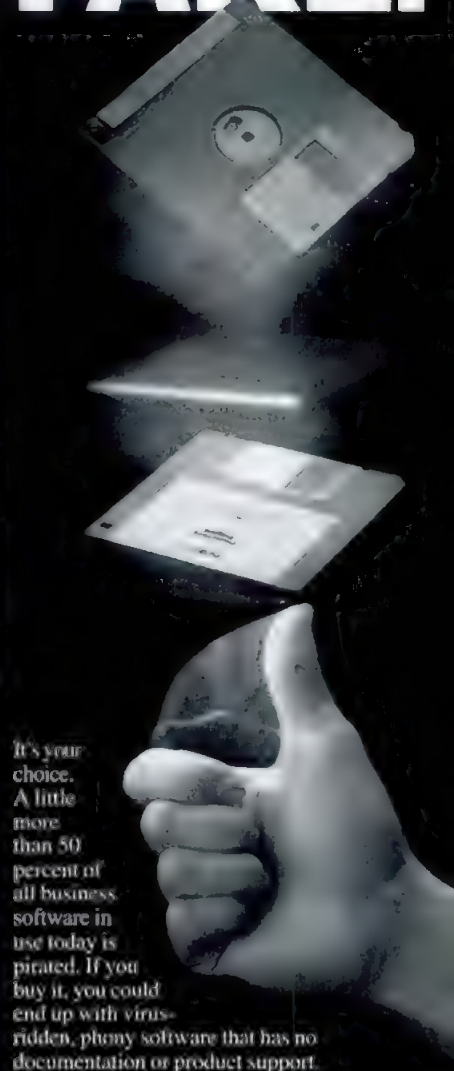
Although it has been panned by some critics, I found G. Pascal Zachary's *Showstopper!* (1994, The Free Press) to be fascinating reading. *Showstopper!* provides a documentary account of Microsoft's four-year effort to create Windows NT. (The title refers to the most severe bugs, or *showstoppers*, that must be eradicated before a software product can be shipped.) It does a masterful job of describing the personal impact of the development effort on the code writers as well as the volatile personality of Microsoft's Dave Cutler.

The book more than makes up for its shortage of technical details with authoritative first-person accounts from the programmers and product managers of the agonies and ecstasies of the development process. You'll come away wondering how anyone could survive the death march that was Windows NT, and with a profound appreciation both for the more than five million lines of code that make up this most complex operating system and for the people who wrote them.

Another book that gives you insight into the world of programmers is *The New Hacker's Dictionary* (Eric S. Raymond and Guy L. Steele, The MIT Press, 1993). It will have you jumping from cross-reference to cross-reference; each definition is funnier than the one before. Here's an example: "**Macintrash** /mak'in-trash/ n. The Apple Macintosh, as described by a hacker who doesn't appreciate being kept away from the *real computer* by the interface. The term **maggotbox** has been reported in regular use in the Research Triangle area of North Carolina. Compare **Macintoy**. See also **beige toaster**, **WIMP environment**, **drool-proof paper**, **user-friendly**." This dictionary is also the only place you'll find definitions for certain technical jargon. And lest Mac lovers feel singled out, it's just as disparaging toward "mess-dos" and "Microsloth Windows."

So don't waste your summer vacation on the latest John Grisham or Anne Rice: Hunker down with some technopulp! □

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Corporate Developer

BY BARRY SIMON

The Windows 95 User Interface

While there has been controversy about how much the plumbing underlying Windows 95 has changed from Windows 3.1, there is no argument that the user interface has been radically overhauled with a new look, new custom controls, and a replacement of the Program Manager/File Manager combination that defined Windows 3.x for so many users. This presents you with an opportunity and a challenge to revamp the UI in your own applications.

In our issue of June 13, 1995, we discussed some of the recommendations in the Windows 95 style guide. We've since received some updated information, which we've included here in the sidebar "Icon Update." In this part, we'll describe some of the interface elements in depth and discuss related guidelines, such as those for Setup. As you may know, the style guide is available in electronic form in the beta SDK, where it is called The Windows Interface Guidelines—A Guide for Designing Software.

USING THE NOTIFICATION AREA In its default configuration, the Windows 95 desktop has a special area called the *taskbar* (shown in Figure 1), located at the bottom of the screen. The central area of the taskbar contains rectangular buttons, which are similar to the icons at the bottom of the Windows 3.1 screen except that they are displayed even when the application is not minimized. There is one button for each running application. Ac-

tual icons on the desktop represent launch *shortcuts* (explained below), not minimized applications, which may confuse users migrating from Windows 3.x.

Users can drag the taskbar to expand to more than one row or to live on the top or on a side edge of the screen. There is even Auto hide, a choice in the Taskbar Properties Sheet that shrinks the taskbar down to a thin line that expands to normal size when the mouse touches it. You can probably assume, however, that most of your users will keep the default. In addition to the built-in system taskbar, applications can set up their own *access bars* using the SHAppBarMessage API. Each such bar can be auto-hidden or placed along whatever edge the user wants.

The Start Menu button is located at the extreme left end of the taskbar. In the Setup Folder Guidelines section, you'll learn how to add your program to this menu. On the extreme right of the taskbar is the Notification Area. By default (on machines with a sound driver) the Notification Area has two objects: a loudspeaker icon and text that shows the current time. In addition to the time, the objects displayed in the notification area can provide information in four ways:

- The objects can supply *ToolTips*, that is, extra textual information that pops up when the cursor pauses over the object. Place the cursor over the time, for exam-

ple, and the date appears as a ToolTip.

- Double-clicking on the object can call up an associated dialog. For the two default objects, double-clicking the speaker icon invokes an elaborate mixer volume control, while double-clicking the time produces the tabbed dialog seen in Figure 2 for setting the date, time, and time zone.
- Clicking once can optionally invoke a different dialog. Clicking once on the time does nothing, but one click on the loudspeaker brings up a simple master volume/mute control.
- A right-click brings up a Property Menu that, following the convention I discussed in the previous column, shows the double-click action in bold, thus providing an alternative for users who have trouble double-clicking.

The Notification Area is dynamic. You

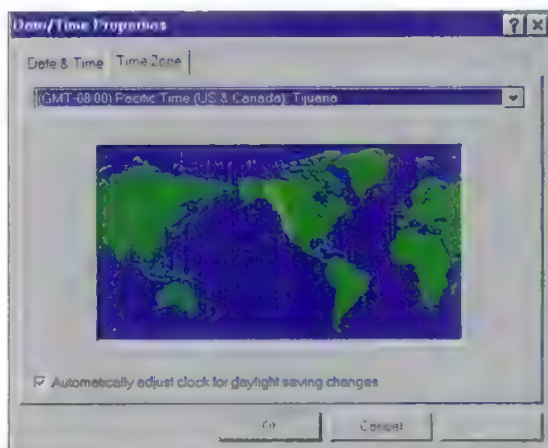


Figure 2: The Time Zone dialog that pops up when you double-click the time on the taskbar.

use the Shell_NotifyIcon API calls (presently documented in the SHELLAPI.H header file included with the SDK) to add and remove your own icons and text objects from the area. These objects can themselves have ToolTips, context menus, and all the other features found in the default objects. For example, when the Microsoft Network connects, it adds a modem icon to the Notification Area.

The Notification Area is an ideal place to tell your user when the application needs attention. For example, if the app goes out to the network to collect a lot of data, you could put an icon in the Notification Area to let the user know when the app is finished. This is preferable to flashing your icon, since it is less rudely insistent. Take care, though, to remove the no-

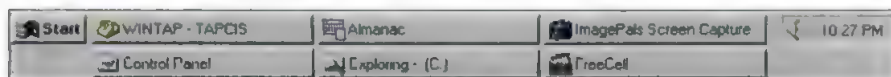


Figure 1: The Windows 95 taskbar showing the Start Menu button at its extreme left.

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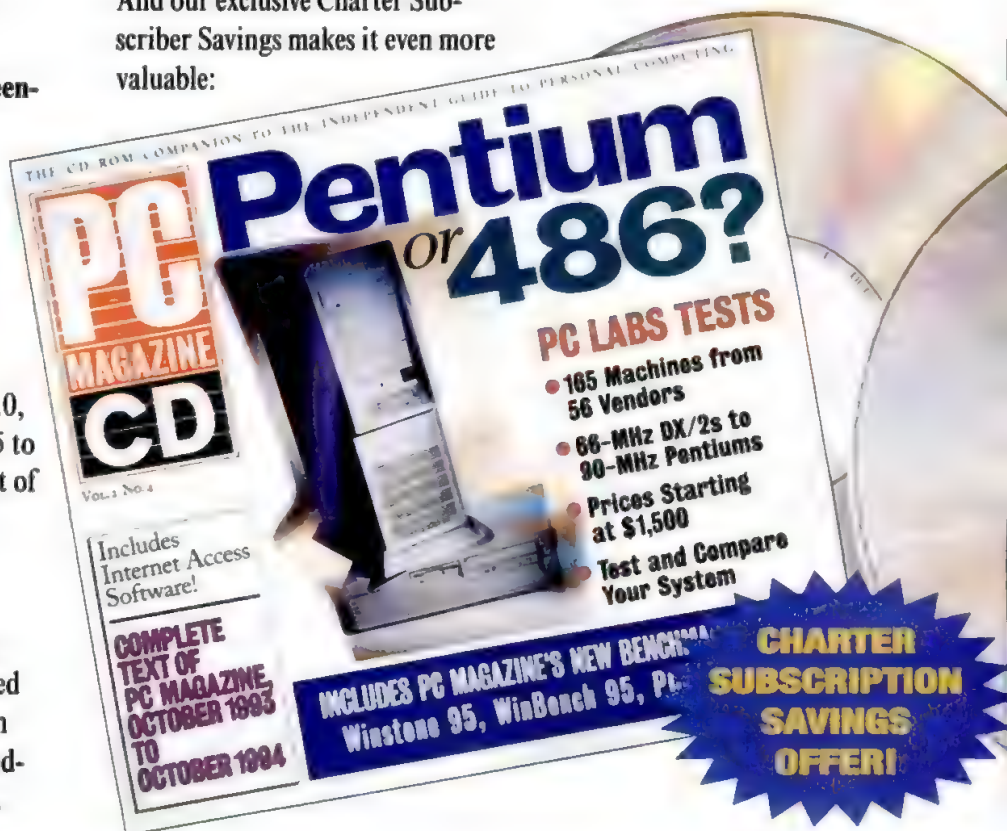
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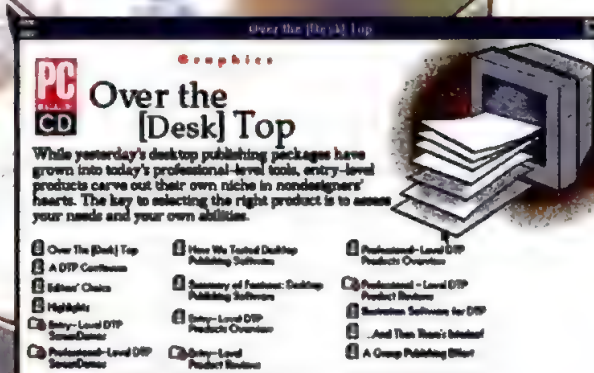
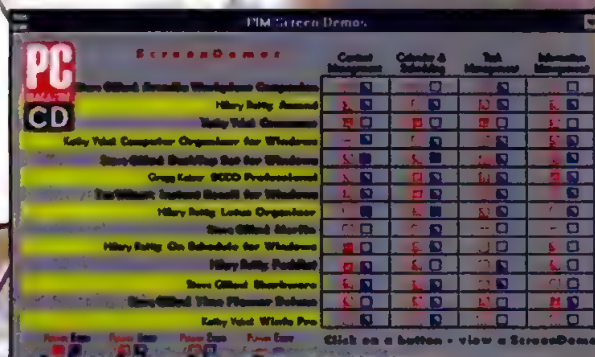
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tification icon after the user resumes interacting with your application: The area is likely to become a scarce resource for many users as programmers learn of its power.

FOLDERS In Windows 95, directories are called *folders*. Files are used for more than their traditional roles as containers of data and as executables. The system has folders that organize much more than data. For example, the icons that appear on your desktop are actually files in a folder called Windows\Desktop. (Presumably, you can use any name for the main Windows folder, but its subfolder names are fixed.) If you rename an icon on the desktop, you rename the file in Windows\Desktop at the same time.

Since your executables may need to use a fixed name or may require a number of other files in their directory, you'll need a way to place a launch icon on the desktop without using the actual executable. For this reason, it is best that all desktop items use the new type of Windows 95 file called a *shortcut*. Indeed, the default behavior if you drag an icon from the Win 95 Explorer window to the desktop is to create a shortcut rather than to move the executable.

SHORTCUTS This new file type can be used to execute a program or to take some other action. The most obvious use for shortcuts is to act as launchable icons on the desktop. They are also the Windows 95 equivalents of the items in Program Manager groups.

As mentioned, the default action when

an executable or associated document is dragged to the desktop is to create a shortcut. Making a shortcut is also a non-default action when you drag a file from one folder to another in Explorer. That is, if you drag-and-drop between Explorer windows with the right mouse button, one of the options on the pop-up menu is to create a shortcut. You can also create shortcuts from the File | New menu item in Explorer.

Technically, shortcuts are special binary files that have the extension .LNK. They are normally about 300 bytes in length, but of course they take up the minimum space allocated to any file on an uncompressed disk—16K on a partition sized between 512MB and 1GB, for example. The shortcut file stores a pointer to an icon and to the property information shown in Figure 3. Launching the shortcut by double-clicking on it in a file listing or by double-clicking its icon on the desktop will execute the target command line. Usually, this command line refers to an on-disk file, but it can also refer to such other accessible objects as printers or even dial-up remote computers.

THE START MENU The Windows directory—whoops, folder (you'll find the term takes some getting used to!)—contains a folder called Start Menu. That's right: two words, as allowed by the long filenames supported in Windows 95. The bottom six items on the Start Menu shown in Figure 4 are built in; the top three are the names of files and folders in my own system's \Windows\Start Menu folder.

If you choose a Start Menu item that corresponds to a file, Windows tries to run that file. If it is an executable or a document associated to an executable, Windows will run the file as if you had double-clicked on it in an Explorer window. The best procedure is to store

shortcuts in the Start Menu subfolders; if the user chooses an item corresponding to a shortcut, Windows "runs the shortcut," which in turn runs the action with which the shortcut is associated.

The subfolders of the Start Menu are submenus. These submenus can in turn contain files that appear as items, and subfolders that appear as sub-submenus. Windows creates one folder in \Windows\Start Menu called Windows\Start

Menu\Programs. If a user installs a Win 3.1 application under Windows 95 and that application uses DDE calls to install a group in Program Manager, Windows 95 makes a new subfolder of Windows\Start Menu\Programs instead of creating a group. What would have become Program Manager items becomes shortcuts in that new folder.

Another folder of importance is called Program Files, which the Windows 95 Setup places off the root

of the drive on which Windows 95 is installed. It makes a subfolder called Accessories and places files like WordPad and Paint there. This is the recommended default location for application programs.

THE COMMON CONTROLS Just as the COMMCTL.DLL was an important component for providing Windows 3.1 apps with a familiar look, so the use of a new "Common Controls" DLL (COMCTL32.DLL) will be important for designing Windows 95 applications. This DLL includes the following:

- Header Control (a window for displaying multiple columns of data, as Figure 5 shows)
- List View (a way to display objects as icons with labels; much like a Win 3.1 Program Manager window)
- Progress Bar
- Property Sheet
- Status Bar
- Toolbar
- Trackbar (slider control)
- Tree View (an outline-type list, as in the Windows 95 Help Contents page)
- Up-Down Control, also known as a spin control.

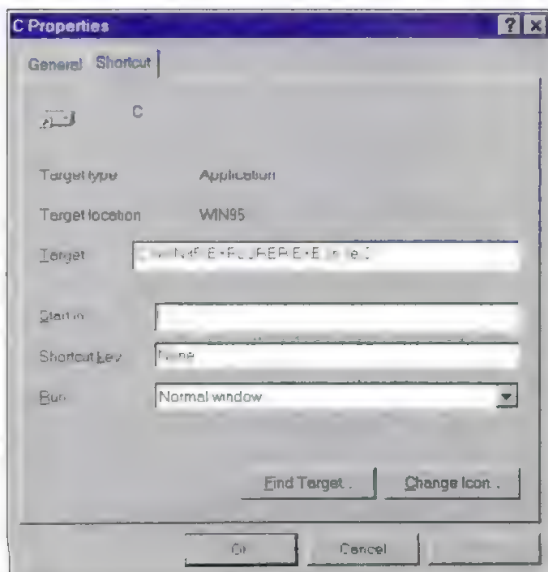


Figure 3: The Property sheet for a shortcut.

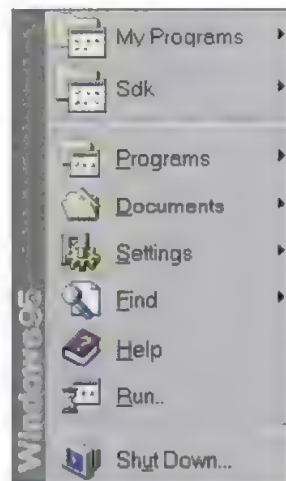


Figure 4: The Start Menu.



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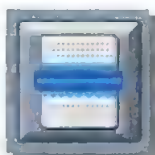
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Canon

REGISTRY The Windows 3.1 Registration Database has been replaced by the Registry, which is stored in two files: USER.DAT and SYSTEM.DAT. The Registry has a tree structure much like the directory tree. Any node can have both subnodes and entries. Entries have the form key=value.

The Windows 95 tree structure can become quite involved. For example, the font names previously stored in WIN.INI now go into the node HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Fonts. The font name is the key and filename is the value.

SETUP FOLDER GUIDELINES The Windows 95 Guide to Programming, currently available as a help file (GUIDE.HLP) in the Windows 95 SDK, contains a chapter called "Application Setup Guidelines." Setup is the first aspect of your program to which users are exposed, and structural decisions you make there can impact the user forever after. You should therefore view a properly crafted Setup and an associated Uninstall as important parts of your overall UI.

The guidelines contain several strong recommendations concerning the folder structure you use for your application. Among them:

- Although you can allow the user to choose another location, by default place your application in a subfolder of the \Program Files folder.



Figure 5: The Windows 95 Header Control lets the user sort on a column by clicking on the column label.

■ Icon Update

In the June 13, 1995, Corporate Developer column, I cited Microsoft's Windows 95 style guide recommendation that you supply three icon formats for your applications: small (16-by-16 pixels with 16 colors), large (32-by-32 pixels with 16 colors), and a new high-resolution format (48-by-48 pixels with 256 colors). I've received some updated information on these that especially relates to the new format.

The small icon is used in the upper corner of the title bar (where the system menu button appears in Windows 3.x) and in the taskbar. The large icon is used in icon view in Explorer windows and on the desktop. The new format, however, is used only under very special circumstances, at least for now. In the Property Sheet for the display is an item that allows the user to specify icon size on the

desktop. The default is 32-by-32. A user who increases this to 48 will get to see any 48-by-48 icon you provide. However, for applications that don't supply 48-by-48 icons—including the System—all the icons will look so awful that it is unlikely you'll find many users who want to shift to this format. I might add that as of this writing the SDK provides no tools to create the new high-resolution icons.

For now, 48-by-48 icons are an investment in the future. Microsoft says that a prospective system enhancement may make use of them, but if your development resources are stretched, you can probably skip the new format. Windows 95 places more demands on you as a developer, because you are expected to deal with issues that you might have skipped in the past; let that be enough for the present.—Barry Simon

- If you have any unshared DLLs, VxDs, or other "technical" files, put them in a subfolder of your program folder called \System. As we'll see shortly, your program can locate these DLLs by using application-specific paths.
- If at all possible, install a single icon in the Start Menu (using the IShellLink

API) and make it a link in the Windows\Start Menu\Programs folder. I'll discuss the reasons behind this recommendation below.

- Do not place any files in the \Windows or \Windows\System folders. Shared DLLs are the only exception to this rule.

If you are using a shared DLL, always check whether the DLL is already present. If it is, overwrite it only if your version is newer. If the DLL is already there, be sure to increment its counter, which can be found in the Registry, in HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\SharedDLLs. The value for a key in the shared

components section is the number of applications that have registered their intention to use that component. If you find that the key is already present with a count of 3, for example, you should change that value to 4. If it's not present, you should insert the Registry entry with a count of 1.

If you think about how most applications are currently structured, the hardest guideline to follow may be to place only *one* icon in the Start Menu. Usability studies by Microsoft suggest that novice users get very confused by multiple icons. Sophisticated users are likely to have many programs and find a plethora of cascading menus a pain. (Such users may want to organize existing icons, and fortunately doing so is easy. Since the Start Menu mirrors the branch of the folder tree it begins, reorganizing the Start Menu is as simple as dragging shortcuts around in Explorer.)

The guidelines urge you to place tutorials and readme files as menu items in your main application rather than giving them separate icons. Collections of utilities, on the other hand, will continue to need a separate submenu.

APPLICATION-SPECIFIC PATHS Users are increasingly running up against the 127-character limit of the DOS path string. Although Windows 95 supports the DOS path string for compatibility, Windows 95 programs are supposed to use an application-specific path that is stored in the Registry.

Paths usually serve two purposes: They let the user start an application from anywhere, and they allow a program to locate DLLs and other system files. These needs are now to be met with two separate keys, which are placed in a new branch of the Registry. Let's say, for instance, that your program is FOOBAR.EXE, it's in the folder \Program Files\Foo Folder, and you want its subfolder system in your application path as

*Windows 95 provides a
wealth of tools to craft
your UI—so many that
it's often overwhelming.*

well. You first add a node called D:\Foo Data, and then you add a node called: HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\AppPaths\foobar.exe. This node should have two keys. One key has the name "Default" and the value C:\Program Files\Foo Folder. The other key has the name "Path," and you'd give it the value C:\Program Files\Foo Folder\System;D:\Foo Data; (note that path strings must end in a semicolon).

A few installation issues remain. You are supposed to provide a method for uninstalling your application and to register that method in the Registry. You add a subnode to HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Uninstall with your program name and supply two keys: a name for your application to display to the user, and a command string to be run if the user chooses your application from the Add/Remove Program applet of the Control Panel.

Included with the SDK is a custom version of Sterling Software's Install Shield,

which provides installation technology for developers. Install Shield supports a rich scripting language, but a template is provided that lets you set up installations without mastering all the scripting language.

Windows 95 provides a wealth of tools to craft your UI—so many that it is often overwhelming. In this two-part piece, I've introduced you to some of the issues you'll need to address as you migrate your

applications to this new world. Each will require considerable study as you explore the details. For now, the best source of further information is the Windows 95 SDK CD-ROM. Look especially in the folders called ADMIN\RESKIT\DOCS (the Resource Kit), \WIN32SDK\MS-TOOLS\HELP (the programmers' guide, in Help format), and \WIN32SDK\DOC\UISTYLE (the style guide). □

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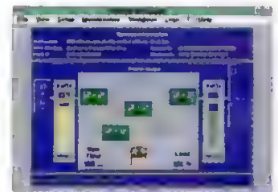
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Toolkits

BY PETER G. AITKEN

Support-File Insurance

Developers who distribute Visual Basic applications often have to deal with end-user problems caused by the presence of the wrong DLL or VBX files. This occurs when other applications overwrite these files with incompatible versions. VersionStamper-VB (\$129), from Desaware, cannot prevent such problems, but it can make them easier to diagnose and solve. It lets your programs tell you what the problem file is by embedding information about the names, versions, and file dates of the modules a program needs to run. It also stores Windows version resource information about your program for use by others.

VERSION INFO At the heart of VersionStamper is a custom control named DWVSTAMP.VBX. During program design, the control can automatically scan your project to determine what custom controls it uses and what DLLs are referenced in DECLARE statements, along with their file dates and version numbers. While this is rarely necessary, you can also manually select from a list of the DLLs and VBXs on your disk.

For each required module, you can specify the conditions under which an incompatibility will be reported. The default is to trigger a warning only if an older version is found on the user's system (with "older" based on either the module's version resource, if present, or the file date and time stamp). You can change this so that a warning is triggered if a newer version is found or if the "special" flag in the module's version stamp is set. When you compile the program, these requirements are embedded within the executable file.

You enter your program's own version

resource information as control Properties. This information is stored in a Windows-defined format, and other installation programs can use it to prevent accidental overwriting of later versions. You can embed both file and product version numbers. File version numbers are used to keep track of revisions of particular program files—for example, a frequently updated DLL. Both the file and product version numbers can have two major and two minor parts (for example, 3.1.0.5). You can also include your company's name, a copyright notice, and a legal trademark notice. There are flags to indicate prerelease, debug, or patched versions, as well as some "generic" flags for specialized use. Build Date, Internal Name, and Original Filename are among the two dozen or so other embeddable fields.

Each time a program that uses VersionStamper is loaded, the DWVSTAMP control examines the host system to ensure that the required modules are present and then reports any incompati-

bilities. The VersionStamper-VB package includes standard Visual Basic forms and code to perform a default check, and you can write your own code (or modify the standard components) to create a customized check that displays specific information, such as a message to call customer support.

What if the program won't load at all? This can happen if the VersionStamper control is called to detect incompatibilities after the program has requested the services of an incompatible DLL or VBX. The user can then run a separate "rescue" program that analyzes programs built with VersionStamper-VB and reports incompatibilities between the program's required files and the resources on the disk. The rescue program is written in Visual Basic, and the source code is provided. You can freely distribute the rescue program as is or customize it to suit your specific needs.

VersionStamper-VB is a snap to use, thanks to good program design and excellent documentation. If you write Visual Basic programs just for yourself or for a small group of coworkers, VersionStamper-VB is probably not necessary. But for wider program distribution, whether department-wide or worldwide, it can be a helpful addition to your tool chest. □

VersionStamper-VB, Version 1.0. List price: \$129. Requires: Microsoft Visual Basic 3.0, Windows 3.1 or later. Desaware, 5 Town and Country Village, # 790, San Jose, CA 95128; 408-377-4770; fax, 408-371-3530.

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OFF THE STACK

● **Sheridan Software Systems' Calendar Widgets** (\$139) is a set of reusable components for displaying the date and time within a program. The package includes both 16-bit Visual Basic custom controls (VBXs) and 32-bit OLE controls (OCXs), built from a common code base. Three controls—DayView, MonthView, and YearView—offer views of the calendar. The fourth, DateCombo, provides flexible input and format masks. *Sheridan Software Systems; 516-753-0985; fax, 516-753-3661.*

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● **HighEdit** (\$299), from Pinnacle Publishing, is a Visual Basic custom control that lets developers add sophisticated word processing capabilities to their applications. HighEdit can handle files larger than 64K and allows you to customize its look to mimic other word processors. Version 3.0 adds a print preview feature, RTF (rich text format) 1.2 data exchange, table object support, multilevel undo, and multiline data fields. *Pinnacle Publishing; 800-788-1900, 206-251-1900; fax, 206-251-5057.*

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CIRCLE 201 ON READER SERVICE CARD

Power Programming

BY PETE DAVIS AND JIM MISCHER

Undocumented WinHelp, Part 1

Microsoft Windows Help has received quite a bit of press over the last 18 months or so, with two books dedicated to it, an annual conference that attracts more than 200 developers, a magazine (*The WinHelp Journal*), and numerous articles that discuss all aspects of the feature, from the very basic to detailed descriptions of undocumented WinHelp features.

One largely unknown—and highly misunderstood—feature of WinHelp is its ability to call third-party DLL functions as custom macros. Help-file password protection, expandable Contents pages, watermarks, and multifile keyword-search facilities are just a few examples of features that have been added to WinHelp through the use of custom macros.

Microsoft documents much of the WinHelp DLL interface in its Help Authoring Guide, which is available on the Microsoft Development Library CD-ROM and also as HAG.ZIP in the WIN-SDK forum on CompuServe. In this article, we're going to examine some parts of the DLL interface that Microsoft didn't document and show you how to use these undocumented features to create a DLL that keeps track of who accessed a help file and when.

The discussions in this article apply only to Version 3.10.425 of WINHELP.EXE—the version that ships with Windows 3.1. We have not verified that any of this information is applicable to WinHelp 4.0, which will ship with Windows 95.

HELP FILE INTERNALS One item that Microsoft doesn't document is the internal format of a Windows Help (.HLP) file. This is an unfortunate omission, be-

cause many advanced features (such as collapsible Contents pages) need to obtain information from the .HLP file in order to work. The .HLP file format has been partially documented—albeit unofficially—by Pete Davis in the "Undocumented Corner" column of the September and October 1993 issues of *Dr. Dobbs's Journal*. We're not going to provide a detailed description of the .HLP file format in this column—just a very brief overview to help in understanding the discussions that follow.

Internally, a .HLP file is actually a complete file system, with a header, directory, and individual *bag files* (logical files inside of the .HLP file) that hold the help topic's text, keywords, and other information required by WinHelp to display your help files. Bag files are also used to store bitmaps that you include by reference and files that you include in the [BAGGAGE] section of your help project file. WinHelp provides a number of callback functions that allow you to access the Help File System (HFS) from your DLLs in much the same manner as you would access the DOS file system from a Windows program.

DLLs AND CALLBACK FUNCTIONS DLLs that implement simple custom help macros are no different from DLLs that you write for other languages. For example, a DLL function to beep the PC's speaker could be called by a C program, or as a help macro. But when you get into

WinHelp-specific functions such as searching for a particular topic in a help file, you have to write your DLL so that it will communicate with WinHelp. The Help Authoring Guide describes the WinHelp DLL interface in detail and gives several examples of DLLs that interact with WinHelp. We're going to cover the basics here. For more detailed information, consult the Help Authoring Guide.

WinHelp communicates with a DLL by calling the DLL's `LDLLHandler()` function. The C prototype for this function is

```
long _far _pascal _export
LDLLHandler (WORD wParam,
LPARAM lParam1, LPARAM lParam2);
```

WinHelp passes messages to `LDLLHandler()` to inform the DLL of certain WinHelp events. Events WinHelp notifies the DLL about include initialization and termination, jumps, and window-activation messages. When the DLL is first loaded

(the first time any function in the DLL is called by WinHelp), WinHelp sends a `DW_WHATMSG` message to `LDLLHandler()`, and the DLL returns a value specifying the events it wants WinHelp to notify it about.

If a DLL requests it, WinHelp will send a `DW_CALLBACKS` message and a pointer

to a table of callback functions that the DLL can use to read help files and obtain other information about the current state of WinHelp. Microsoft documents 16 of these callback functions and includes their prototypes in the `DLL.H` file included with the Help Authoring Guide. Here are the documented callback functions:

- `HFSOpenSz()` opens an existing help file.
- `RCCloseHFS()` closes an open help file.
- `HFOpenHFS()` opens a named bag file in an open help file.
- `RCCloseHF()` closes an open bag file.
- `LCBReadHf()` reads information from a bag file.

Microsoft didn't document all there is to know regarding the DLL interface. Here are some features you probably haven't heard about.


```

/*
  HELPDLL.H -- More definitions for WinHelp DLLs

  Copyright 1994, Jim Mischel
*/
#include "dll.h" // Include standard definitions

// Undocumented message sent to DLLs
#define DW_ACTIVATEWIN 11

// Undocumented callback function offsets
#define HE_FChSizeHF 17
#define HE_HFCreateFileHFS 18
#define HE_RCUnlinkFileHFS 19
#define HE_RCFlushHF 20
#define HE_LCBWriteHF 21
#define HE_RCRenameFileHFS 22
#define HE_RCABandonHF 23
#define HE_HFSCreateFileSys 24
#define HE_RCDestroyFileSys 25
#define HE_Last 26

#define VPTR_Size (HE_Last * sizeof (VPTR))

// Type definitions for undocumented callbacks
typedef BOOL (FAR PASCAL *LPFN_FCHSIZEHF) (HF f, LONG qlSize);
typedef HF (FAR PASCAL *LPFN_HFCREATEFILEHFS) (HFS fs, LPSTR szName);
typedef RC (FAR PASCAL *LPFN_RCUNLINKFILEHFS) (HFS fs, LPSTR szName);
typedef RC (FAR PASCAL *LPFN_RCFLUSHHF) (HF f);
typedef LONG (FAR PASCAL *LPFN_LCBWRITEHF) (HF f, LPBYTE qb, LONG LCB);
typedef RC (FAR PASCAL *LPFN_RCRENAMEFILEHFS) (HFS fs, LPSTR szOldName, LPSTR szNewName);
typedef RC (FAR PASCAL *LPFN_RCABANDONHF) (HF f);
typedef HFS (FAR PASCAL *LPFN_HFSCREATEFILESYS) (LPSTR szName, LONG Something);
typedef RC (FAR PASCAL *LPFN_RCDESTROYFILESYS) (LPSTR szName);

// DLL items structure
typedef struct tagwhDLLStruc {
    unsigned StackSeg; // unique instance identifier
    VPTR FPtrs; // table of callback functions
    void far * Extra; // DLL-specific instance data
    struct tagwhDLLStruc *Next; // pointer to next item in list
} whDLLStruc, far * whDLLPtr;

typedef void (far *whDLLFreeFunc) (void far *p);

// functions defined in HELPDLL.C
BOOL far pascal GetWinHelpCallbacks (VPTR VPtr, long lVersion);
void far pascal EndWinHelpDLL (whDLLFreeFunc Func);
whDLLPtr far pascal GetCurrentModule (void);

#define CreateDLLInstance GetCurrentModule

// WinHelp callback function macros
#define HFSOpenSz (szName, fMode) \
    ((LPFN_HFSOPENSZ) (GetCurrentModule())->FPtrs[HE_HfsOpenSz]) \
    (szName, fMode)
#define RCCloseHFS (fs) \
    ((LPFN_RCCLOSEHFS) (GetCurrentModule())->FPtrs[HE_RcCloseHfs]) \
    (fs)
#define HFOpenHFS (fs, szName, bFlags) \
    ((LPFN_HFOPENHFS) (GetCurrentModule())->FPtrs[HE_HfOpenHfs]) \
    (fs, szName, bFlags)
#define RCCloseHF (f) \
    ((LPFN_RCCLOSEHF) (GetCurrentModule())->FPtrs[HE_RcCloseHf]) \
    (f)
#define LCBReadHF (f, qb, LCB) \
    ((LPFN_LCBREADHF) (GetCurrentModule())->FPtrs[HE_LcbReadHf]) \
    (f, qb, LCB)
#define LTellHF (f) \
    ((LPFN_LTELLHF) (GetCurrentModule())->FPtrs[HE_LTellHf]) \
    (f)
#define LSeekHF (f, lOffset, wOrigin) \
    ((LPFN_LSEEKHF) (GetCurrentModule())->FPtrs[HE_LSeekHf]) \
    (f, lOffset, wOrigin)
#define FEOFHF (f) \
    ((LPFN_FEOFHF) (GetCurrentModule())->FPtrs[HE_FEOFHf]) \
    (f)
#define LCBSIZEHF (f) \
    ((LPFN_LCBSIZEHF) (GetCurrentModule())->FPtrs[HE_LcbSizeHf]) \
    (f)
#define FAccessHFS (fs, szName, bFlags) \
    ((LPFN_FACCESSHFS) (GetCurrentModule())->FPtrs[HE_FAccessHfs]) \
    (fs, szName, bFlags)
#define ErrorW (nError) \
    ((LPFN_ERRORW) (GetCurrentModule())->FPtrs[HE_ErrorW]) \
    (nError)
#define ErrorSz (ErrMsg) \
    ((LPFN_ERRORSZ) (GetCurrentModule())->FPtrs[HE_ErrorSz]) \
    (ErrMsg)
#define LGetInfo (wItem, hwnd) \
    ((LPFN_LGETINFO) (GetCurrentModule())->FPtrs[HE_GetInfo]) \
    (wItem, hwnd)
#define FAPI (qchHelp, wCommand, ulData) \
    ((LPFN_FAPI) (GetCurrentModule())->FPtrs[HE_FAPI]) \
    (qchHelp, wCommand, ulData)
#define RCLLInfoFromHF (f, wOption, qFid, qlBase, qlCB) \
    ((LPFN_RCLLINFOFROMHF) \
    (GetCurrentModule())->FPtrs[HE_RcLLInfoFromHf]) \
    (f, wOption, qFid, qlBase, qlCB)
#define RCLLInfoFromHFS (fs, szName, wOption, qFid, qlBase, qlCB) \
    ((LPFN_RCLLINFOFROMHFS) \
    (GetCurrentModule())->FPtrs[HE_RcLLInfoFromHfs]) \
    (fs, szName, wOption, qFid, qlBase, qlCB)
#define FChSizeHF (f, qlSize) \
    ((LPFN_FCHSIZEHF) (GetCurrentModule())->FPtrs[HE_FChSizeHF]) \
    (f, qlSize)
#define HFCreateFileHFS (fs, szName, bFlags) \
    ((LPFN_HFCREATEFILEHFS) \
    (GetCurrentModule())->FPtrs[HE_HFCreateFileHFS]) \
    (fs, szName, bFlags)
#define RCUnlinkFileHFS (fs, szName) \
    ((LPFN_RCUNLINKFILEHFS) \
    (GetCurrentModule())->FPtrs[HE_RCUnlinkFileHFS]) \
    (fs, szName)
#define RCFlushHF (f) \
    ((LPFN_RCFLUSHHF) (GetCurrentModule())->FPtrs[HE_RCFlushHF]) \
    (f)
#define LCBWriteHF (f, qb, LCB) \
    ((LPFN_LCBWRITEHF) \
    (GetCurrentModule())->FPtrs[HE_LCBWriteHF]) \
    (f, qb, LCB)
#define RCRenameFileHFS (fs, szOldName, szNewName) \
    ((LPFN_RCRENAMEFILEHFS) \
    (GetCurrentModule())->FPtrs[HE_RCRenameFileHFS]) \
    (fs, szOldName, szNewName)
#define RCABandonHF (f) \
    ((LPFN_RCABANDONHF) (GetCurrentModule())->FPtrs[HE_RCABandonHF]) \
    (f)
#define HFSCreateFileSys (szName, Something) \
    ((LPFN_HFSCREATEFILESYS) \
    (GetCurrentModule())->FPtrs[HE_HFSCreateFileSys]) \
    (szName, Something)
#define RCDestroyFileSys (szName) \
    ((LPFN_RCDESTROYFILESYS) \
    (GetCurrentModule())->FPtrs[HE_RCDestroyFileSys]) \
    (szName)

// LGetInfo crackers
#define LGetHInstance() (HINSTANCE) LGetInfo (GI_HINSTANCE, 0)
#define LGetMainHwnd() (HWND) LGetInfo (GI_MAINHWND, 0)
#define LGetCurrHwnd() (HWND) LGetInfo (GI_CURRHWND, 0)
#define LGetHFS (wnd) (HFS) LGetInfo (GI_HFS, wnd)
#define LGetFGColor (wnd) LGetInfo (GI_FGCOLOR, wnd)
#define LGetBKColor (wnd) LGetInfo (GI_BKCOLOR, wnd)
#define LGetTopicNo (wnd) LGetInfo (GI_TOPICNO, wnd)
char far * LGetHPath (HWND wnd); // in HELPDLL.C

```

Figure 1: This collection of C macros and a small linkable module maintain multiple instances of WinHelp function pointers with a minimum of effort. It also shows the C definitions for nine undocumented WinHelp callback functions and their corresponding offsets in the table passed to LDLLHandler() with the DW_CALLBACKS message.

- LTellHF() returns the current position of the file pointer in an open bag file.
- LSeekHF() sets the file pointer position in an open bag file.
- FEOFHF() determines if end of file has been reached on an open bag file.
- LCBSIZEHF() returns the size of an open bag file.
- FAccessHF() determines whether a particular bag file exists.
- RCLLInfoFromHF() obtains low-level information about an open bag file.

- RCLLInfoFromHFS() obtains low-level information about a named bag file.
- ErrorW() displays a standard WinHelp error message in a message box.
- ErrorSz() displays a programmer-defined error message in a message box.
- LGetInfo() returns global information about the WinHelp application.
- FAPI() allows the DLL to perform WinHelp() API functions.

The pointers to these callback functions are stored in positions 1 through 16

of the table that WinHelp passes to LDLLHandler() with the DW_CALLBACKS message.

UNDOCUMENTED WINHELP CALLBACKS
What the Help Authoring Guide doesn't tell you is that there are nine additional callback functions that let you create and modify help files and bag files. The callback addresses for these functions are contained in positions 17 through 25 of the table that's passed to LDLLHandler() with the DW_CALLBACKS message.




```

// Helper Functions
// Copyright 1994 by Microsoft

// This module contains the helper functions for the
// WinHelp API. These functions are used by the
// WinHelp API to manage the help system.

// The following functions are defined in this module:
//
// 1. FChSizeHF() - Changes the size of an existing
//    help file.
// 2. HFCreatFileHFS() - Creates a new help file
//    in an existing HFS.
// 3. RCUnlinkFileHFS() - Deletes a help file
//    from an existing HFS.
// 4. RCFlushHF() - Flushes the write buffers
//    on a help file.
// 5. LCBWriteHF() - Writes data to a help file.
// 6. RCRenameFileHFS() - Renames a help file
//    in an existing HFS.
// 7. RCAbandonHF() - Discards any changes
//    made to a help file.
// 8. RCDestroyFileSys() - Destroys a help file
//    system.
// 9. HFCreateFileSys() - Creates a new help file
//    system.

// The following functions are defined in the
// WinHelp API:
//
// 1. WinHelp() - Displays a help file.
// 2. WinHelpEx() - Displays a help file with
//    additional options.
// 3. WinHelpData() - Returns the data for a
//    help file.
// 4. WinHelpDataEx() - Returns the data for a
//    help file with additional options.
// 5. WinHelpDataEx2() - Returns the data for a
//    help file with additional options.
// 6. WinHelpDataEx3() - Returns the data for a
//    help file with additional options.
// 7. WinHelpDataEx4() - Returns the data for a
//    help file with additional options.
// 8. WinHelpDataEx5() - Returns the data for a
//    help file with additional options.
// 9. WinHelpDataEx6() - Returns the data for a
//    help file with additional options.
// 10. WinHelpDataEx7() - Returns the data for a
//    help file with additional options.
// 11. WinHelpDataEx8() - Returns the data for a
//    help file with additional options.
// 12. WinHelpDataEx9() - Returns the data for a
//    help file with additional options.
// 13. WinHelpDataEx10() - Returns the data for a
//    help file with additional options.
// 14. WinHelpDataEx11() - Returns the data for a
//    help file with additional options.
// 15. WinHelpDataEx12() - Returns the data for a
//    help file with additional options.
// 16. WinHelpDataEx13() - Returns the data for a
//    help file with additional options.
// 17. WinHelpDataEx14() - Returns the data for a
//    help file with additional options.
// 18. WinHelpDataEx15() - Returns the data for a
//    help file with additional options.
// 19. WinHelpDataEx16() - Returns the data for a
//    help file with additional options.
// 20. WinHelpDataEx17() - Returns the data for a
//    help file with additional options.
// 21. WinHelpDataEx18() - Returns the data for a
//    help file with additional options.
// 22. WinHelpDataEx19() - Returns the data for a
//    help file with additional options.
// 23. WinHelpDataEx20() - Returns the data for a
//    help file with additional options.
// 24. WinHelpDataEx21() - Returns the data for a
//    help file with additional options.
// 25. WinHelpDataEx22() - Returns the data for a
//    help file with additional options.
// 26. WinHelpDataEx23() - Returns the data for a
//    help file with additional options.
// 27. WinHelpDataEx24() - Returns the data for a
//    help file with additional options.
// 28. WinHelpDataEx25() - Returns the data for a
//    help file with additional options.
// 29. WinHelpDataEx26() - Returns the data for a
//    help file with additional options.
// 30. WinHelpDataEx27() - Returns the data for a
//    help file with additional options.
// 31. WinHelpDataEx28() - Returns the data for a
//    help file with additional options.
// 32. WinHelpDataEx29() - Returns the data for a
//    help file with additional options.
// 33. WinHelpDataEx30() - Returns the data for a
//    help file with additional options.
// 34. WinHelpDataEx31() - Returns the data for a
//    help file with additional options.
// 35. WinHelpDataEx32() - Returns the data for a
//    help file with additional options.
// 36. WinHelpDataEx33() - Returns the data for a
//    help file with additional options.
// 37. WinHelpDataEx34() - Returns the data for a
//    help file with additional options.
// 38. WinHelpDataEx35() - Returns the data for a
//    help file with additional options.
// 39. WinHelpDataEx36() - Returns the data for a
//    help file with additional options.
// 40. WinHelpDataEx37() - Returns the data for a
//    help file with additional options.
// 41. WinHelpDataEx38() - Returns the data for a
//    help file with additional options.
// 42. WinHelpDataEx39() - Returns the data for a
//    help file with additional options.
// 43. WinHelpDataEx40() - Returns the data for a
//    help file with additional options.
// 44. WinHelpDataEx41() - Returns the data for a
//    help file with additional options.
// 45. WinHelpDataEx42() - Returns the data for a
//    help file with additional options.
// 46. WinHelpDataEx43() - Returns the data for a
//    help file with additional options.
// 47. WinHelpDataEx44() - Returns the data for a
//    help file with additional options.
// 48. WinHelpDataEx45() - Returns the data for a
//    help file with additional options.
// 49. WinHelpDataEx46() - Returns the data for a
//    help file with additional options.
// 50. WinHelpDataEx47() - Returns the data for a
//    help file with additional options.
// 51. WinHelpDataEx48() - Returns the data for a
//    help file with additional options.
// 52. WinHelpDataEx49() - Returns the data for a
//    help file with additional options.
// 53. WinHelpDataEx50() - Returns the data for a
//    help file with additional options.
// 54. WinHelpDataEx51() - Returns the data for a
//    help file with additional options.
// 55. WinHelpDataEx52() - Returns the data for a
//    help file with additional options.
// 56. WinHelpDataEx53() - Returns the data for a
//    help file with additional options.
// 57. WinHelpDataEx54() - Returns the data for a
//    help file with additional options.
// 58. WinHelpDataEx55() - Returns the data for a
//    help file with additional options.
// 59. WinHelpDataEx56() - Returns the data for a
//    help file with additional options.
// 60. WinHelpDataEx57() - Returns the data for a
//    help file with additional options.
// 61. WinHelpDataEx58() - Returns the data for a
//    help file with additional options.
// 62. WinHelpDataEx59() - Returns the data for a
//    help file with additional options.
// 63. WinHelpDataEx60() - Returns the data for a
//    help file with additional options.
// 64. WinHelpDataEx61() - Returns the data for a
//    help file with additional options.
// 65. WinHelpDataEx62() - Returns the data for a
//    help file with additional options.
// 66. WinHelpDataEx63() - Returns the data for a
//    help file with additional options.
// 67. WinHelpDataEx64() - Returns the data for a
//    help file with additional options.
// 68. WinHelpDataEx65() - Returns the data for a
//    help file with additional options.
// 69. WinHelpDataEx66() - Returns the data for a
//    help file with additional options.
// 70. WinHelpDataEx67() - Returns the data for a
//    help file with additional options.
// 71. WinHelpDataEx68() - Returns the data for a
//    help file with additional options.
// 72. WinHelpDataEx69() - Returns the data for a
//    help file with additional options.
// 73. WinHelpDataEx70() - Returns the data for a
//    help file with additional options.
// 74. WinHelpDataEx71() - Returns the data for a
//    help file with additional options.
// 75. WinHelpDataEx72() - Returns the data for a
//    help file with additional options.
// 76. WinHelpDataEx73() - Returns the data for a
//    help file with additional options.
// 77. WinHelpDataEx74() - Returns the data for a
//    help file with additional options.
// 78. WinHelpDataEx75() - Returns the data for a
//    help file with additional options.
// 79. WinHelpDataEx76() - Returns the data for a
//    help file with additional options.
// 80. WinHelpDataEx77() - Returns the data for a
//    help file with additional options.
// 81. WinHelpDataEx78() - Returns the data for a
//    help file with additional options.
// 82. WinHelpDataEx79() - Returns the data for a
//    help file with additional options.
// 83. WinHelpDataEx80() - Returns the data for a
//    help file with additional options.
// 84. WinHelpDataEx81() - Returns the data for a
//    help file with additional options.
// 85. WinHelpDataEx82() - Returns the data for a
//    help file with additional options.
// 86. WinHelpDataEx83() - Returns the data for a
//    help file with additional options.
// 87. WinHelpDataEx84() - Returns the data for a
//    help file with additional options.
// 88. WinHelpDataEx85() - Returns the data for a
//    help file with additional options.
// 89. WinHelpDataEx86() - Returns the data for a
//    help file with additional options.
// 90. WinHelpDataEx87() - Returns the data for a
//    help file with additional options.
// 91. WinHelpDataEx88() - Returns the data for a
//    help file with additional options.
// 92. WinHelpDataEx89() - Returns the data for a
//    help file with additional options.
// 93. WinHelpDataEx90() - Returns the data for a
//    help file with additional options.
// 94. WinHelpDataEx91() - Returns the data for a
//    help file with additional options.
// 95. WinHelpDataEx92() - Returns the data for a
//    help file with additional options.
// 96. WinHelpDataEx93() - Returns the data for a
//    help file with additional options.
// 97. WinHelpDataEx94() - Returns the data for a
//    help file with additional options.
// 98. WinHelpDataEx95() - Returns the data for a
//    help file with additional options.
// 99. WinHelpDataEx96() - Returns the data for a
//    help file with additional options.
// 100. WinHelpDataEx97() - Returns the data for a
//    help file with additional options.
// 101. WinHelpDataEx98() - Returns the data for a
//    help file with additional options.
// 102. WinHelpDataEx99() - Returns the data for a
//    help file with additional options.
// 103. WinHelpDataEx100() - Returns the data for a
//    help file with additional options.

```

Figure 2: These routines, together with HELPDLL.H, provide an extension to the Microsoft-supplied DLL.H, allowing multiple instances of WINHELP.EXE.

The C definitions of the functions and their corresponding offsets in the table are shown in the HELPDLL.H listing in Figure 1. Here are descriptions of the undocumented functions:

- The FChSizeHF() callback function allows you to change the size of an existing bag file in an open HFS. The bag file must be open in order for this function to work. On success, FChSizeHF() returns the file's new size; it returns -1L on error.
- HFCreatFileHFS() creates a new bag file in an existing HFS. The bFlags parameter should be set to fFSOpenRead-Write (0x00) when calling this function. HFCreatFileHFS() returns a handle to the newly created file or 0 if the file was not created.
- RCUnlinkFileHFS() deletes a bag file from an existing HFS. The bag file being deleted should not be open when this function is called. RCUnlinkFileHFS() returns 0 if the file is deleted or one of the standard rcXXX return codes defined in DLL.H if an error occurs.
- RCFlushHF() flushes the write buffers on a bag file that's opened for writing.

- Data written to a bag file is not actually committed to the disk until the buffers are flushed—either by calling this function or by closing the file with RCCloseHF(). RCFlushHF() returns 0 if successful or one of the standard rcXXX return codes on error.
- LCBWriteHF() writes data to a bag file. The bag file must be opened for writing. Note that all writes are buffered, so writing data to the file with this function doesn't guarantee that the data will be committed to disk. You must call RCFlushHF() or RCCloseHF() in order to flush the write buffers to disk. Data written by this function can be "unwritten" by calling RCAbandonHF(). If successful, LCBWriteHF() returns the number of bytes written; it returns -1L on error.
- RCRenameFileHFS() changes the name of an existing bag file in an open HFS. The existing file should not be open when this function is called. This function returns 0 if successful or one of the rcXXX standard return codes on error.
- RCAbandonHF() discards any changes

- made to an open bag file since the last time the write buffers were flushed. It returns 0 if successful or one of the rcXXX standard return codes on error.
- HFCreateFileSys() creates a new HFS file with an empty file system. The purpose of the second parameter, a long integer value, is unknown. Experimentation has shown that a value of 0 for this parameter works and creates a valid HFS file. If successful, this function returns a handle to the newly created help file system, and the file is open and ready for writing. You must call RCCloseHFS() to ensure that any changes you make are written to disk and the internal directory is updated. The function returns 0 if it is unable to create the new file.
- RCDestroyFileSys() deletes an existing help (.HLP) file. The purpose of this function isn't quite clear, as it appears to perform the same function as the standard C unlink() function. RCDestroyFileSys() returns 0 if successful or one of the rcXXX standard return codes on error. A value of rcFailure is returned if you attempt to delete an open HFS file.



RESTRICTIONS As with any undocumented feature, these callback functions are unsupported by Microsoft and may be changed or removed in future versions of WinHelp. Empirical evidence indicates that the functions work as I've described, but your mileage may vary.

One restriction to using these undocumented callbacks is that you can't write to or otherwise modify a help file that WinHelp currently has open. WinHelp opens files for read only and sets the open mode

so that other processes may read but not modify the file. This is unfortunate, because the ability to modify an open help file would make possible any number of very cool features, including encryption of help topics and on-the-fly modification of bitmaps in the help file. There are no similar restrictions on the documented callback functions, because they don't modify the help file.

It's still possible to perform on-the-fly modification of help files, but to do so you

must synchronize two help files—switching to one, modifying the other, and then switching back to the one that you just modified. This is the technique we use in the example program.

MULTIPLE WINHELP INSTANCES When WinHelp passes the callback addresses to a DLL, it's actually passing the address of a table of function pointers that were created with the `MakeProcInstance()` function. When you have multiple instances of WINHELP .EXE running, each in-

```
/*
HACCESS.C -- DLL to keep track of help-file accesses.

Copyright 1995, Jim Mischel and Pete Davis
*/
#include <windows.h>
#include <malloc.h>
#include <time.h>
#include "helpdll.h"
#include "haccess.rh"

#define TEMPORARY_FILE "access.hlp"
#define ACCESS_BAGFILE "access.log"

// DLL instance handle
static HINSTANCE HInstance;
static char FileToModify[128];
static int AccessFlag = 0;
static int ModFlag = 0;

int _far _pascal _export LibMain (HINSTANCE hinst, WORD wDataSeg,
WORD cbHeap, LPSTR lpchCmdLine) {

    HInstance = hinst;
    return TRUE;
}

static void FillListbox (HWND hDlg) {
    HFS hfs;
    HF hf;
    char *filename;
    char *Buffer;
    char *c;
    long FileSize;
    int Counter;
    HWND hwndListbox = GetDlgItem (hDlg, IDC_LISTBOX1);

    filename = LGetHPPath (LGetCurrHwnd ());
    // try to open the help file
    if ((hfs = HFOpenSz (filename, ffsOpenReadOnly)) == 0)
        return;
    free (filename);

    // try to open the bag file
    if ((hf = HFOpenHFS (hfs, ACCESS_BAGFILE, ffsOpenReadOnly)) == 0)
        goto CloseHFS;

    // get file size and allocate buffer
    FileSize = LCBSizeHF (hf);
    Buffer = malloc (FileSize);

    // Read file into buffer
    LCReadHF (hf, (LPBYTE)Buffer, FileSize);

    // now add each string to the list box
    c = Buffer;
    Counter = 0;
    while (Counter < FileSize) {
        SendMessage (hwndListbox, LB_ADDSTRING, 0, (LPARAM)c);
        Counter += strlen (c)+1;
        c += strlen (c)+1;
    }
    free (Buffer);
    RCCloseHF (hf);
CloseHFS:
    RCCloseHFS (hfs);
}

LRESULT FAR PASCAL DisplayDlgProc (HWND hDlg, WORD message,
WPARAM wParam, LPARAM lParam) {
    switch (message) {
        case WM_INITDIALOG :
            FillListbox (hDlg);
    }
}
```

```
return TRUE;

case WM_COMMAND :
    switch (wParam) {
        case IDOK :
            EndDialog (hDlg, IDOK);
            break;
    }
    break;
}
return FALSE;
}

void _far _pascal _export ShowAccess (void) {
    DLGPROC dlgproc;

    // get the name
    dlgproc = (DLGPROC)MakeProcInstance ((FARPROC)DisplayDlgProc,
HInstance);
    DialogBox (HInstance, "DisplayDlg", LGetCurrHwnd (), dlgproc);
    FreeProcInstance ((FARPROC)dlgproc);
}

static char AccessString[61];

LRESULT FAR PASCAL NameDlgProc (HWND hDlg, WORD message,
WPARAM wParam, LPARAM lParam) {
    switch (message) {
        case WM_INITDIALOG : {
            HWND EditBox = GetDlgItem (hDlg, IDC_EDIT1);
            // Clear the input box and set the maximum text length
            SetWindowText (EditBox, "");
            SendMessage (EditBox, EM_LIMITTEXT, 30, 0L);
            return TRUE;
        }

        case WM_COMMAND :
            switch (wParam) {
                case IDOK :
                    GetDlgItemText (hDlg, IDC_EDIT1, AccessString, 30);
                    EndDialog (hDlg, IDOK);
                    break;
            }
            break;
    }
    return FALSE;
}

void _far _pascal _export AddAccess (void) {
    char *c;
    DLGPROC dlgproc;
    time_t ttime;

    if (AccessFlag) {
        AccessFlag = 0;
        return;
    }

    // get the name
    dlgproc = (DLGPROC)MakeProcInstance ((FARPROC)NameDlgProc,
HInstance);
    DialogBox (HInstance, "AccessDlg", LGetCurrHwnd (), dlgproc);
    FreeProcInstance ((FARPROC)dlgproc);

    // append the date and time
    lstrcat (AccessString, " ");
    ttime = time (NULL);
    lstrcat (AccessString, asctime (localtime (&ttime)));
    // remove the newline character
    AccessString[strlen(AccessString)-1] = '\0';

    c = LGetHPPath (LGetCurrHwnd ());
    lstrcpy (FileToModify, c);
    free (c);
}
```



Figure 3: HACCESS.C is a WinHelp DLL that implements a help-file access log that prompts the user for a name when a help file is loaded. It appends the entered name and the current time into a bag file within that help file.


```

AccessFlag = 1;
ModFlag = 1;
Fapi (TEMPORARY_FILE, HELP_FORCEFILE, 0L);
}

static void UpdateAccess (char *Filename) {
    HFS hfs;
    HF hf;

    if (ModFlag-->0)
        return;

    // try to open the help file
    if ((hfs = HFSOpenSz (Filename, fFSOpenReadWrite)) == 0)
        return;
    // try to open the bag file
    if ((hf = HFOpenHFS (hfs, ACCESS_BAGFILE, fFSOpenReadWrite)) == 0) {
        // it doesn't exist, create it.
        hf = HFCreateFileHFS (hfs, ACCESS_BAGFILE, fFSOpenReadWrite);
    }
    // seek to the end of the file
    LSeekHF (hf, 0, wFSSeekEnd);
    // and write the string
    LCBWriteHF (hf, (LPBYTE)AccessString, lstrlen (AccessString)+1);
    RCCloseHF (hf);
    CloseHFS:
    RCCloseHFS (hfs);
}

/* LDLLHandler -- Respond to WinHelp messages */
long _far _pascal _export LDLLHandler (
    WORD wMsg, LONG lParam1, LONG lParam2) {

```

```

switch (wMsg) {
    /*
     * Return value indicates the types of messages that
     * you want to receive.
     */
    case DW_WHATMSG :
        return (DC_CALLBACKS | DC_INITTERM | DC_JUMP);

    /* Get callback addresses */
    case DW_CALLBACKS :
        GetWinHelpCallbacks ((VPTR)lParam1, lParam2);
        return TRUE;
    case DW_INIT :
        return TRUE;
    /* Received immediately before the DLL is unloaded */
    case DW_TERM :
        EndWinHelpDLL (NULL);
        return TRUE;
    /* Received after a jump is completed */
    case DW_ENDJUMP :
        if (AccessFlag) {
            UpdateAccess (FileToModify);
            Fapi (FileToModify, HELP_FORCEFILE, 0);
        }
        return TRUE;
    /* Ignore any other messages */
    default :
        return FALSE;
}
}

```

stance has its own table of function pointers that it passes to DLLs. If your DLL isn't written to handle multiple WinHelp instances (and most should be, as there's no way to prevent WinHelp from trying to load the DLL twice), it's very likely that you'll end up with a General Protection Fault at some point in your DLL. For example, suppose that you have a DLL that obtains the callback function pointers from WinHelp in order to access the

help file from within the DLL. The first instance of WinHelp that loads the DLL will pass the function pointers to your DLL, which copies the pointers to its own memory space. A second WinHelp instance that loads the DLL passes a different set of function

pointers that, if your DLL isn't written to handle multiple instances, will be copied on top of the first instance's function pointers. Your DLL will appear to function normally except that LGetInfo() may sometimes return erroneous values. If you close the second instance of WinHelp, though, then the function pointers that your DLL is maintaining are now invalid and calling any one of them will most likely result in a GPF.

The trick to maintaining multiple instances of the callbacks usually involves a

linked list of callback function arrays—one for each instance—and some code to ensure that the correct instance is always referenced whenever you call one of the callback functions. The code to do this can get pretty messy, and customizing it for every different WinHelp DLL gets tiresome after the third or fourth time. Because I hate modifying boilerplate code to fit particular situations, I spent some time experimenting and came up

The trick to maintaining multiple instances of the callbacks usually involves a linked list of callback function arrays.

with a collection of C macros and a small linkable module that maintains the multiple instances with a minimum of effort. You'll find these macros in the HELPDLL.H file (Figure 1), which also contains the type definitions of the undocumented WinHelp callbacks and function

prototypes for the routines defined in HELPDLL.C (Figure 2).

Logically, HELPDLL.H and HELPDLL.C are extensions of DLL.H, the WinHelp DLL header file that Microsoft distributes with the Help Authoring Guide on the Developer Network CD and in the file HAG.ZIP, which you can download from CompuServe. Since HELPDLL.H includes DLL.H, you can replace any references of DLL.H in your WinHelp DLLs with references to HELPDLL.H.

HOW IT WORKS The heart of the multiple instance support supplied by HELPDLL.H and HELPDLL.C is the GetCurrentModule() function. This function maintains a linked list of WinHelp instances that have loaded the DLL, along with each instance's callback function pointers and any DLL-specific information for each instance. The structures in the list look like this:

```

typedef struct tagwhDLLStruc {
    unsigned StackSeg;
    VPTR FPtrs;
    void far * Extra;
    struct tagwhDLLStruc *Next;
} whDLLStruc, far * whDLLPtr;

```

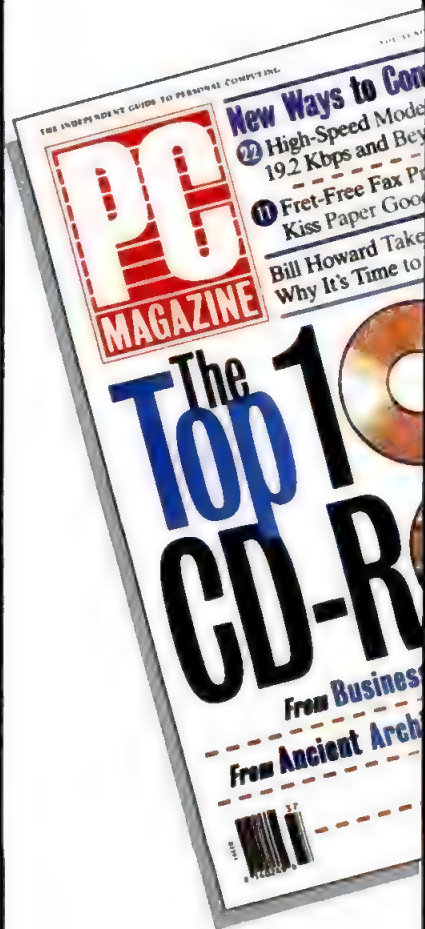
The reason we use the stack segment value rather than the instance handle to identify the particular WinHelp instance is because we had some problems with the GetCurrentTask() function in an early release of Windows NT.

The FPtrs field is simply a pointer to a block of memory that was allocated to hold the function pointers for this instance of WinHelp. The variable Extra can be used by the DLL to allocate memory that must be unique for each instance. The EndWinHelpDLL() function in HELPDLL.C will automatically free this memory, or if necessary your DLL can pass EndWinHelpDLL() a pointer to a function that deallocates the memory.

GetCurrentModule() obtains the cur-


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rent stack segment value and locates the structure in the list that corresponds to that stack segment value. If no such structure exists, `GetCurrentModule()` allocates and initializes a new structure with that stack segment value. In any case, `GetCurrentModule()` returns a pointer to the structure that contains data for the current instance.

The `GetWinHelpCallbacks()` function, which your `LDLLHandler()` function should call when it receives the `DW_CALLBACKS` message from WinHelp, calls `GetCurrentModule()` to create a new instance structure in the linked list and then copies the callback function addresses from the table that WinHelp passed.

The remainder of `HELPDLL.H` contains C macros that make calling the callback functions relatively painless. These macros obtain a pointer to the current instance's data structure and then call the function from the instance's list of callback functions. For example, the definition of `LCBWriteHF` is

```
#define LCBWriteHF(f,qb,LCB) \
((LPFN_LCBWRITEHF)(GetCurrent\
Module())->FPtrs[HE_LCBWriteHF])\
(f, qb, LCB)
```

The code that's generated when you write

```
LCBWriteHF(f, (LPBYTE)Buffer,
BufferSize);
```

is equivalent to

```
whDLLPtr p = GetCurrentModule();
LPFN_LCBWRITEHF WriteHf = p->FPtrs
[HE_LCBWriteHF];
WriteHf(f, (LPBYTE)Buffer,
BufferSize);
```

There is some small overhead involved in calling `GetCurrentModule()` every time you access a callback function, but nothing that calls these functions will be particularly performance-sensitive, and the alternative involves a lot of `GetCurrentModule()` function calls interspersed throughout your code, which is messy and tough to get just right.

AN EXAMPLE HACCESS.C (Figure 3) is a WinHelp DLL that implements a

help-file access log that prompts the user for a name when a help file is loaded. It appends the entered name and the current time into a bag file within that help file. The access recorder is implemented in the `AddAccess()` custom macro. A companion macro, `ShowAccess()`, can be called to display a list of the people who have accessed the help file.

To test `HACCESS`, you must compile `HACCESS.C` and `HELPDLL.C` and link them with the resource files, `HACCESS.RC` and `HACCESS.RH`, which contains the resource identifiers.

Use the Help Compiler (`HC.EXE`) to construct the test help file, `ACCTEST.HLP`, from `ACCTEST.HPJ` and `ACCTEST.RTF`. The `[CONFIG]` section in `ACCTEST.HPJ` defines the custom macros and calls the `AddAccess()` function to get the user's name and write the name and time to the `ACCESS.LOG` bag file that's contained in `ACCTEST.HLP`. The single topic in `ACCTEST.RTF` contains a hotspot that when pressed calls the `ShowAccess()` macro to display a list of the people who have accessed the help file.

In order for `AddAccess()` to work, it must load a different help file, add the access information to `ACCTEST.HLP`, and then reload `ACCTEST.HLP`. The temporary help file that's loaded, `ACCESS.HLP`, is constructed by the help compiler from `ACCESS.HPJ` and `ACCESS.RTF`. All of these files can be downloaded from ZiffNet (on CompuServe); look for the file `HACC.ZIP` in the Power Programming Library section of the Programming Forum (`GO ZNT:PROGRAM`). □

PETE DAVIS IS AN INDEPENDENT CONTRACTOR WORKING PRIMARILY FOR WEXTech SYSTEMS. HE IS CURRENTLY WRITING A BOOK TENTATIVELY TITLED *UNDOCUMENTED WINDOWS FILE FORMATS*, WHICH SHOULD BE AVAILABLE THIS SUMMER FROM R&D PUBLICATIONS. PETE CAN BE REACHED ON COMPU SERVE AT 71644,3570.

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Utilities

BY JONATHAN WALDMAN

Track Down Files With File Hunter

With entry-level hard disks at a whopping 500MB and networked systems commonly many times larger, a modern PC's files are scattered across a veritable maze of directories. Windows has a rudimentary search facility within File Manager that lets you search for files by name, but you can't search by any other criteria and you can search only a single directory (and optionally its subdirectories) at one time.

What if you want to search multiple drives or find all files newer than a certain date or larger than a certain size? This issue's utility, File Hunter, gives you all these capabilities and more. Unlike File Manager's search feature, File Hunter accepts multiple drives, multiple directories, and multiple file masks, and also finds files based on attribute, time, date, and size values. For convenience, you can launch File Hunter in the usual way or from the File Manager menu.

You can obtain File Hunter by downloading its files from the Internet or CompuServe's ZiffNet service or by mail. (See the sidebar "Guide to Our Utilities & How to Get Them.") File Hunter was written in Visual Basic 3.0, and its accompanying dynamic link library, FMXTENDR.DLL, was written using Visual C++ 1.51.

INSTALLING FILE HUNTER To install File Hunter's components correctly, run its setup program (SETUP.EXE). Setup will create a directory for File Hunter and copy these three files into it: FILEHUNT.EXE, FILEHUNT.HLP, and FMXTENDR.DLL. It will also ensure that three required Visual Basic system

files (THREED.VBX, MSAFINX.DLL, and VBRUN300.DLL) are in your Windows System directory. Lastly, if you choose to add File Hunter to the File Manager menu, Setup will modify WIN-FILE.INI.

If you choose to add File Hunter to the File Manager menu, Setup will create a menu called PCMagazine from which File Hunter and up to three other optional applications can be launched (see Figure 1). If you don't select this option but later want to activate it, you can always rerun Setup. Details on using the File Manager menu option are discussed below.

When File Hunter is launched from the PCMagazine custom menu, it reads File Manager's current directory and uses that as the starting directory. If File Hunter is started from its Program Manager icon, it uses the root of the current drive as the starting directory. In either case, File Hunter begins with its main

screen showing a single directory in the Directories text box (see Figure 2). You can fully customize which directories to search and also which file masks to apply (in the text box directly beneath the Directories text box).

The Directories text box expects you to enter a valid drive letter followed by a directory. To specify more than one directory, simply add a semicolon (";") between each item in your list. For example, to search C:\DOS, C:\WINDOWS, and D:\UTILS\MOSTUSED, you would enter the following:

```
C:\DOS;C:\WINDOWS;D:\UTILS\MOSTUSED
```

The File Masks combo box accepts a list of filenames or file types you would like File Hunter to find. It is in this box that you would enter a specific filename, such as MEMO.DOC. You can also search for all memo files by using a filename that contains MS-DOS wildcard characters, such as MEMO*. (which specifies all files beginning with MEMO). Just as with the Directories text box, you can enter multiple file masks as long as you use a semicolon to delimit each entry.

Common file masks have been predefined in File Hunter. To access them, click the down arrow on the File Mask combo box.

Two controls help you work with the selected Directories and File Masks. To quickly enter all drives in the Directories edit control, click the Quick-Fill Available Drives command button. You can then edit out the drives you don't want to search (for example, floppy disk drives or RAM disks).

The Include Subdirectories check box tells File Hunter to search the subdirectories under the directories you specified. This is a global switch; File Hunter searches subdirectories for either *all* or *none* of the directories in the list.

The Hit List list box occupies the mid-section of the Main screen (see Figure 3). After File Hunter searches your drives, the files found are listed here—up to two billion of them. Each line contains the filename, the file's size (in bytes), its date and time stamp, its attributes, and the directory in which it is stored. DOS attributes appear as a string of characters. A

Top 10 Utilities

Rank	Utility
1	FDDLLS - Finds dead DLLs
2	FINDIR - IRQ line analysis
3	TAPECA - Windows calculator
4	WTIME - Keeps PC clock accurate
6	PLICON - Places program icons
6	SCHED - Runs programs automatically
7	MYGRPS - Customizes group icons
8	QUICKO - Copies disks in one pass
9	WINCMD - Command file interpreter
10	ALLPAP - Customizes bitmap images

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

minus sign means the attribute did not exist for the current file. If a letter appears, it means that the file had the attribute specified (R=read only; H=hidden; S=system; A=archive). The Hit List is always sorted by drive and by directory name.

If you want to select Directories and File Masks from a list box rather than type

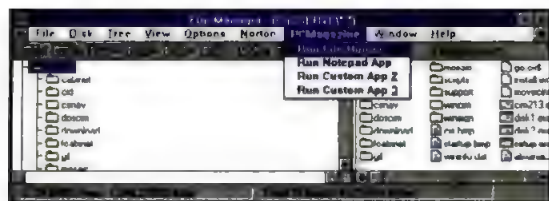


Figure 1: If you choose, File Hunter will add a menu item to File Manager called PCMagazine. From there you can launch File Hunter and up to three other user-specified programs.

them in, or if you want to use additional criteria for selection, click the Advanced... button to access the Advanced Options dialog box (see Figure 4). In the top left corner of this Advanced Options screen is a set of radio buttons for selecting one of two views: Directory Options and File Mask Options. Directory Options appears first by default.

By selecting the Directory Options view, you can choose the drives and directories to include in the search. You browse your storage media with the controls on the right labeled Available Directories and Available Drives. When you find a directory you'd like to include in the search, click the Add button and the currently selected drive and directory appear in the Search In These Directories list box.

If you make an error, you can remove an item from the list box by highlighting it and pressing Remove. If you want to clear the list box, click Remove All. An Include Subdirectories check box with the same function as its main screen counterpart appears under the list box. It is duplicated for convenience and its setting is transferred automatically to the Main screen.

To select file masks, change to the File Mask Options view. The File Mask controls work the same way as the Drive and Directory controls. You can select predefined masks or enter your own.

The File Attributes section at the top right corner of the dialog box and the spe-

cial selection criteria along the bottom are present in both the Directory and File Mask views. Each check box in the File Attributes panel can be in one of three states: checked, unchecked, or grayed. If a box is checked, then only files containing that attribute will appear in the Hit List. If a box is unchecked, then only those files without that attribute will appear. Finally, if a box is grayed, then files will appear in the list whether or not they have the attribute.

The lower quarter of the Advanced screen is dedicated to date, time, and size filters. These filters are applied during a search only when a corresponding Apply box is checked.

For instance, to specify a date filter, check the Date box. You will then see appropriate text boxes and labels (refer again to Figure 4). The Condition column contains a combo box, which can be set to such choices as "later than," "on or before," or "between." If you choose "between" or "not between," an additional text box appears for entering your date range. The last column contains simple advice on the format expected when you hand-enter your date, time, and size values. If both time and date values are present, they are used together. In fact, all search options you specify are considered together.

When you click OK in the Advanced Options window, you will be returned to File Hunter's Main screen and your options will apply to the next hunt. If you specified directories and file masks, they appear automatically in the Directories and File Masks edit boxes.

File Hunter begins its search when you click the Hunt button, which changes to Cancel after the process begins. To abort a hunt, click the Cancel button or press the Esc key. During the hunt, you will see an animation of a spinning, stepping hard disk. Since file searches can take some time, you can minimize File Hunter and go onto other tasks while the search is progressing. The minimized

icon displays the number of found files as its title.

When the search is completed, the File Hunter window will reopen automatically and the Hit List will be activated. To scroll through the list, access the vertical scroll bar with the mouse or use the directional keys on the keyboard. You can also pan right and left to reveal directory names or file details.

You can redefine your search criteria and begin a new hunt at any time. If you want help, click Help. If you want to see program acknowledgments as well as resource information, click About. To exit File Hunter, press the Close button.

EXTENDING FILE MANAGER To "extend" File Manager, you need to supply it with a DLL that accepts File Manager-specific messages. When File Manager has been "extended," a menu is typically placed on its menu bar. File Hunter includes its own DLL (FILEHUNT.DLL), which installs a new menu called PCMagazine (see Figure 1). When this DLL is placed in WINFILE.INI under the section called [AddOns], the extension DLL can send messages to and receive messages from File Manager. The PC-

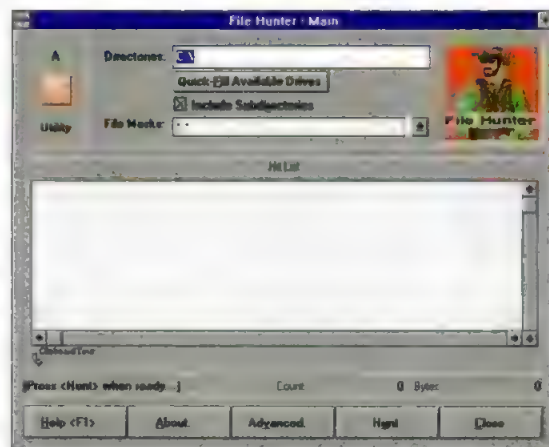


Figure 2: File Hunter's Main screen lets you specify directories and file masks at the top and displays "hits" in a list in the center. When you want to display more options, press the Advanced... button.

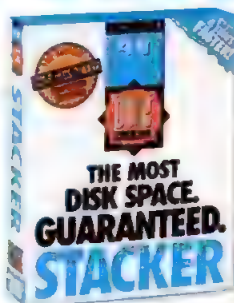
Magazine menu selections launch programs that are defined under the [FileHunter] section of WINFILE.INI. Setup automatically creates this section for you when you choose the File Manager installation option. After a complete installation, File Hunter's WINFILE.INI entries look like this:

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```
[AddOns]
PC Magazine FileHunterDll=C:\FILEHUNT
\FILEHUNT.DLL
[FILEHUNT]
FileHunter=C:\FILEHUNT\FILEHUNT.EXE
;MenuText1={Custom appl menuitem
;text)
;App1={Specify your custom appl here}
;MenuText2={Custom app2 menuitem
;text)
;App2={Specify your custom app2 here}
;MenuText3={Custom app3 menuitem
;text)
;App3={Specify your custom app3 here}
```

Notice that although Setup chooses the File Hunter installation directory by default, you can place FILEHUNT.DLL in any directory you choose—just make sure that WINFILE.INI points to the correct path. FILEHUNT.DLL is not a file you would want in \WINDOWS\SYSTEM, because it is not a DLL that you'd expect other applications to require or share. Programs that want to share the DLL will access WINFILE.INI themselves. For example, if you run The Norton Desktop for Windows (NDW) as your Windows shell, you will notice "PC-Magazine" on your desktop's main menu bar. Apparently, the folks at Symantec

vate the appropriate WINFILE.INI line (that is, remove the line's leading semi-colon character), add the full path of an application next to an App= entry, and then set its corresponding MenuItem text. For example, to launch *PC Magazine's* SuperPad utility as your first customized item, create this entry:

```
MenuText1=Run SuperPad
App1=C:\WINDOWS\SPAD.EXE
```

You can create similar entries for App2 and App3. If an App entry has no assignment, or if the specified application cannot be launched, FILEHUNT.DLL generates an error message.

INSIDE FILE HUNTER I had three major goals when writing File Hunter. First, I wanted to demonstrate how extension DLLs can be used and, in doing this, show how File Hunter can "read" File Manager's current directory and be launched from a File Manager menu. Support for these features required writing a custom dynamic link library, which I called FMXTENDR.DLL (File Manager Extender).

Second, I wanted File Hunter to demonstrate the use of a recursive search algorithm that works its way through a drive's directory tree. This was accomplished with a recursive function and Visual Basic's directory control.

And third, I wanted the Hit List to be able to handle an almost unlimited number of files, despite the inherent limit in the Visual Basic list box control. To do this, I used Visual Basic's list box control to create a virtual list box by intercepting events and using Windows API calls.

THE FILE MANAGER DLL DLLs designed to enhance an existing application are referred to as *extension DLLs*.

File Hunter's FMXTENDR.DLL is an extension DLL designed specifically for the Windows File Manager applet. Some applications, like Symantec's NDW, can imitate File Manager's ability to make use of extension DLLs specifically designed for File Manager. Under Windows 3.x, File Manager accommodates up to five extension DLLs.

File Manager extensions differ from standard DLLs in three ways. First, you must include the WFEXT.H header file so that messages and structures specific to File Manager are available. Extension DLLs must respond to two message types: *notification messages* (defined by File Manager) and *menu-action messages* (defined by the extension DLL and sent by File Manager).

Second, you must export a function called FMExtensionProc, because File Manager sends all extension-related messages to this function. Since FMExtension is the only function in the extension DLL that File Manager calls, it generally consists of a big "switch" statement that traps those messages you want to process. FMExtensionProc is a callback function—that is, Windows calls it directly.

Third, you must define a menu resource. The menu resource defined by FMXTENDR.DLL (which is contained in the source file FMXTENDR.RC) looks like this:

```
PCMagMenu MENU DISCARDABLE
BEGIN
MENUITEM "Run File Hunter", _
IDM_PCMAGAZINE_RUNFILEHUNT
MENUITEM "Run Custom App &1", _
IDM_PCMAGAZINE_RUNCUSTOMAPP
MENUITEM "Run Custom App &2", _
IDM_PCMAGAZINE_RUNCUSTOMAPP2
MENUITEM "Run Custom App &3", _
IDM_PCMAGAZINE_RUNCUSTOMAPP3
END
```

File Manager sends these IDM_menu-action messages to FMExtensionProc whenever a user chooses a menu item.

File Manager sends a variety of notification messages, but the File Hunter DLL needs to process only FMEVENT_LOAD, the message sent whenever the File Hunter DLL is loaded. In response to FMEVENT_LOAD, the extension DLL must supply information about the menu, which will be added to File Manager's menu bar. It does this by populating a structure called FMS_LOAD (defined within wfext.h).

Once FMEVENT_LOAD is processed, the custom menu is available to the user. Whenever the user selects the menu, a menu-action message is sent to FMExtensionProc. These menu items

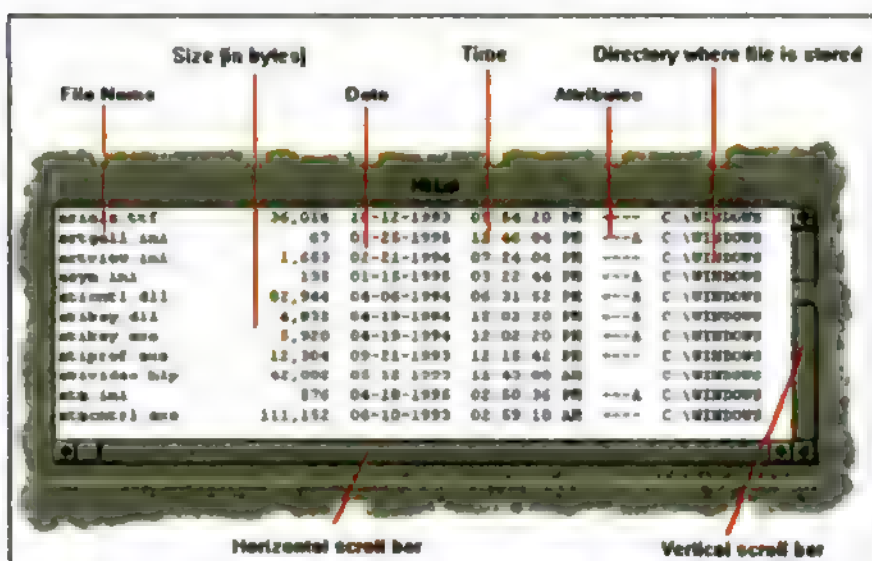
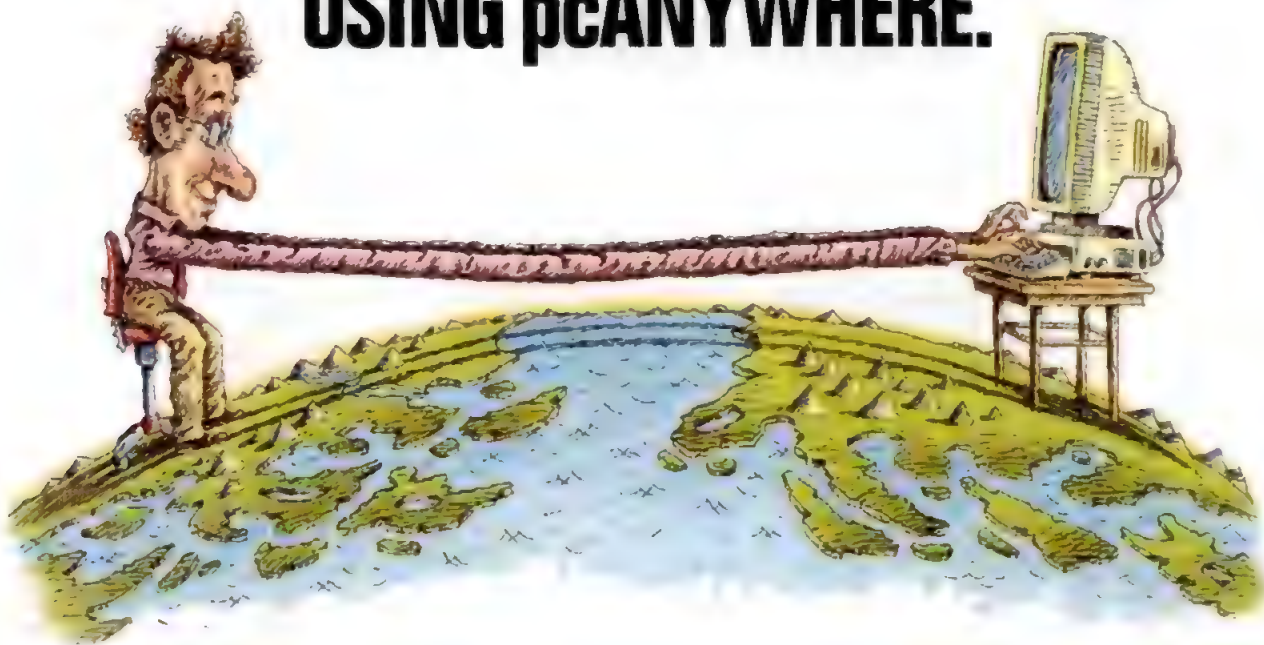


Figure 3: File Hunter's Hit List shows you exactly where your files are located and displays other file details, such as date, time, and size.

were clever enough to include a configuration option that ensures NDW reads WINFILE.INI during start-up.

The PCMagazine menu has four items: one for File Hunter and the rest for custom applications. I felt it was wasteful to create a custom menu to launch only File Hunter, so I expanded the menu to provide an easy way to launch up to three custom programs. To do this, simply acti-

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are processed individually. One of these messages, IDM_PCMAZINE_RUNFILEHUNT, lets the extension know that the Run File Hunter menu item was chosen.

When the DLL receives the IDM_PCMAZINE_RUNFILEHUNT menu-action message, it immediately uses GetPrivateProfileString to view WINFILE.INI's [FMXTENDR] section. Under this section, the FileHunter= entry provides the full path to the File Hunter executable, FILEHUNT.EXE.

Next, the DLL sends the FM_GETDRIVEINFO message to File Manager in order to retrieve its currently dis-

tion is called DirRecursion (in MAIN.FRM), and it accepts a starting directory as its only argument.

Let's assume a directory structure that looks like this:

```
C:\ANIMAL
C:\ANIMAL\BIRD
C:\ANIMAL\MAMMAL
C:\ANIMAL\MAMMAL\PRIMATE
C:\ANIMAL\MAMMAL\UNGULATE
C:\ANIMAL\REPTILE
C:\MINERAL
C:\VEGETABL
```

And let's assume that when DirRecursion is first called, the starting directory path is C:\, which contains three directories: ANIMAL, MINERAL, and VEGETABL. DirRecursion works with the Visual Basic directory control by setting its Path property to the starting directory passed as a parameter. Thus, when the directory control's Path property is set to C:\, the control will contain the three items C:\ANIMAL, C:\MINERAL, and C:\VEGETABL.

A FOR/NEXT loop cycles through each directory in the directory control. As it processes each directory, DirRecursion calls itself with the new directory

as the starting path. In our example, the second call to DirRecursion sets the directory control's Path property to C:\ANIMAL, the first subdirectory under the root. The directory control is refreshed and then contains three directories: BIRD, MAMMAL, and REPTILE. Since DirRecursion was called anew, it executes the same way it did before. A new FOR/NEXT loop is initiated at the new level of recursion, and it cycles through C:\ANIMAL's available directories: C:\ANIMAL\BIRD, C:\ANIMAL\MAMMAL, and C:\ANIMAL\REPTILE. DirRecursion is called again using C:\ANIMAL\MAMMAL as its Path property value, and the recursion continues in this manner.

Each time a FOR/NEXT loop terminates (when it has exhausted the directories available in the directory control at the current level of recursion), DirRecur-

sion ends and returns. When it returns, it continues in the FOR/NEXT loop it was in during the previous level of recursion and sets the directory control's Path property to the next available directory. Since a FOR/NEXT loop is used to keep track of File Hunter's position in a directory tree, the previous recursion level can continue to execute where it left off. Thus, as new directories are encountered, DirRecursion calls itself; as directories are completely processed, DirRecursion returns to its previous recursion level. When the last return is made, the DirRecursion function has completely processed all subdirectories under its original starting path. Be aware that this recursive process cannot work reliably if a background process is changing the directory tree.

During the recursion process, File Hunter scans all files in each directory and determines which files should be added to the Hit List. Fortunately, file masks are handled by the Visual Basic file control's Pattern property. This property accepts a single mask or a semicolon-delimited list, so the Pattern property can be assigned directly from File Hunter's File Masks field.

To obtain a file's attributes, I use the GetAttr Visual Basic built-in function. This function accepts a filename as an argument and returns the file's attributes in a single integer value. To determine which attributes are set for the specified file, I create a Boolean expression and evaluate the result. For instance, this code can determine whether the read-only attribute is set:

```
ReadOnlySet% = _
  GetAttr("C:\MYFILE.TXT") _
  AND ATTR_READONLY
If ReadOnlySet% then
    ' read-only is set
else
    ' read-only is not set
end if
```

Constants such as ATTR_READONLY are supplied with Visual Basic in a file called CONSTANT.TXT. Attributes are analyzed in the function called AddToHitList (in MAIN.FRM).

A file's date and time stamp can be obtained with the Visual Basic built-in function called FileDateTime. This func-



Figure 4: The Advanced Options dialog box lets you choose directories, file masks, DOS attributes, and date, time, or size filters.

played drive and directory. This information is passed to File Hunter on the command line. File Hunter always looks at the command line for its starting directory. If none is supplied, it uses the current directory.

The DLL then calls the custom LaunchMe function, which uses the ShellExecute function to launch the FILEHUNT program. LaunchMe checks for errors and will display an error message if necessary. The LaunchMe function is responsible for launching any of the apps pointed to by the PCMagazine menu items.

RECURSIVE DIRECTORY SEARCH Properly scanning a drive for files requires a method that ensures that all directories and subdirectories are examined. The most effective way to do this is to employ recursion. A recursive function is one that calls itself. File Hunter's recursive func-

Which Database is Easier to Use?

Access vs. Alpha Five

60 Lines of Code

Microsoft Access

If this looks tough, you may want to pick up a few books about Access programming.

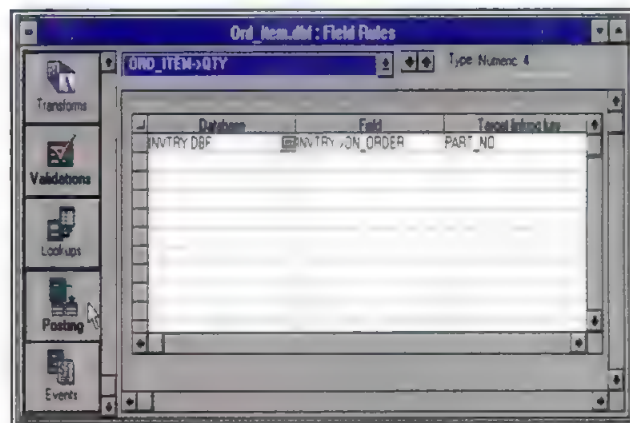
```
Sub Form_AfterUpdate ()
    Dim varRet As Variant
    Dim lngNewItemID As Long
    Dim dblNewQuantity As Double
    Dim qdfInventory As QueryDef
    Dim dbCurrent As Database
    Dim rstInventory As Recordset
    Dim intResponse As Integer
    Dim strMessage As String
    Const MB_YESNO = 4
    Const MB_ICONQUERY = 32
    Const MB_DEFBUTTON2 = 256
    Const ID_YES = 6
    Const ID_NO = 7
    Set dbCurrent = dbEngine.Workspaces(0).Databases(0)
    ' First, renumber any order lines that have changed
    varRet = RenumberDetail()
    ' Now, deal with inventory problems
    ' First, get the new item and quantity for this line
    lngNewItemID = Me![ItemID]
    dblNewQuantity = Me![Quantity]
    ' To update the inventory,
    ' first, run the query to add the old items back in
    ' then, run the query to remove the new items
    Set qdfInventory = dbCurrent.OpenQueryDef("qupdAddingIngredientsForItem")
    qdfInventory.Parameters(0) = dblNewQuantity
    qdfInventory.Parameters(1) = lngItemID
    qdfInventory.Execute
    qdfInventory.Close
    Set qdfInventory = dbCurrent.OpenQueryDef("qupdRemovingIngredientsForItem")
    qdfInventory.Parameters(0) = dblNewQuantity
    qdfInventory.Parameters(1) = lngNewItemID
    qdfInventory.Execute
    qdfInventory.Close
    ' Now, have we run out of stock on anything?
    Set rstInventory = dbCurrent.OpenRecordset("qryExhaustedIngredients", DB_OPEN_SNAP
    SHOT)
    ' If there are any records here, we've got a problem
    If Not rstInventory.EOF Then
        Do While Not rstInventory.EOF
            strMessage = "Warning! Out of stock on " & rstInventory![Description] & ".
            Continue?"
            intResponse = MsgBox(strMessage, MB_YESNO + MB_ICON_QUERY
            + MB_DEFBUTTON2,
            "Inventory Warning")
            If intResponse = ID_NO Then
                ' Go back to original values and pass up the rest of the
                record!
                Me![ItemID] = lngItemID
                Me![Quantity] = dblQuantity
                ' Remember to reverse the changes
                Set qdfInventory =
                Current.OpenQueryDef
                ("qupdAddingIngredientsForItem")
                qdfInventory.Parameters(0) = dblNewQuantity
                qdfInventory.Parameters(1) = lngNewItemID
                qdfInventory.Execute
                qdfInventory.Close
                Set qdfInventory =
                dbCurrent.OpenQueryDef
                ("qupdRemovingIngredientsForItem")
                qdfInventory.Parameters(0) = dblQuantity
                qdfInventory.Parameters(1) = lngItemID
                qdfInventory.Execute
                qdfInventory.Close
                rstInventory.MoveNext
            Exit Do
            End If rstInventory.MoveNext
        Loop
    End If rstInventory.Close
    dbCurrent.Close
End Sub
```

Source: Microsoft Access
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tion accepts a filename as an argument and returns a string containing the date and time value. The Visual Basic built-in function called FileLen determines a file's length in bytes. This function accepts a filename and returns a long integer. These date, time, and size search filters are analyzed in the function called KeepMeAnalysis (in FILEHUNT.BAS).

THE VIRTUAL LIST

BOX File Hunter's Hit List presents a list of all files that could be located on your system given the search options you provided. Because of Windows limitations, Visual Basic's list box can hold a maximum of 5,440 rows or roughly 64K of data, whichever limitation is reached first. Since each line of the Hit List

can potentially contain 128 characters, I was concerned that file searches on modern computers might easily exceed these limitations. Most programmers would solve this problem by using a "bound" list box, driven by a database such as an Access MDB file. I wanted to illustrate a tighter approach that does not require the overhead of distributing VB's database-support DLLs, which take up almost a full megabyte.

My approach uses two temporary random-access files. The first holds file information such as filename, time and date stamp, size, and attributes; the second contains directory names. I chose to store the directory names in a separate file because an MS-DOS directory can be as many as 64 characters (not including the drive letter and colon), and repeating the directory name for each file would consume a lot of space.

Instead of storing the directory with the other file information, I store a long integer (4 bytes) that points to a physical record in the directory file that contains full 64-byte directory names. Each time a file is found, File Hunter determines whether the directory where the file resides has already been written to the directory file. If it has, then the record number corresponding to that directory is

stored in the file-information file's long integer field (and the other file information is written as well). If the directory has not yet been encountered, then a new record is written to the directory file, and the new record number is stored in the file-information file. In essence, this method uses two temporary random files to emulate a relational database.

The temporary files are created in the TEMP directory defined by the system's TEMP environment variable. If TEMP is not defined, then Windows uses the Windows directory by default. The first four characters of temporary files created by File Hunter are ~PCM (for *PC Magazine*). File Hunter

deletes these files when it terminates normally. If File Hunter terminates abnormally (because of a power failure, for instance), then you will have to delete the ~PCM*. * files manually. Because File Hunter always generates unique filenames for its temporary files, you can launch it multiple times within a single Windows session.

A unique temporary filename is generated with the GetTempFileName Windows API call. It is declared for Visual Basic like this:

```
Declare Function GetTempFileName Lib _
"Kernel" (ByVal cDriveLetter As _
Integer, ByVal lpPrefixString As _
String, ByVal wUnique As Integer, _
ByVal lpTempFileName As String) As _
Integer
```

Temp files generated in this manner always begin with a tilde character, and you can customize the characters that follow the tilde by setting the lpPrefixString value. You can also pass a number to use for the remaining digits. If you pass a zero (as File Hunter does), you get a number that corresponds to a unique filename. The API function first builds a numeric string based on the current system time and tries that in the filename. If the name

is in use, it increments the number repeatedly until it finds a name that's not in use. Be certain to allocate adequate space in a string buffer to hold the lpTempFileName value before making the call. If you don't, you will most certainly experience a General Protection Fault.

Storing the Hit List in temporary files represents the back end of the virtual list box. Creating the front end required a few changes to how the list box functions and interacts with a Visual Basic program. The most important adjustment is to the scroll bar control.

Visual Basic's vertical scroll bar control works by using its Min (minimum) and Max (maximum) properties to determine what value to convey to a program. But these values must be integers. Since File Hunter uses a long integer as a record number pointer, I could not use physical record numbers as the Min and Max values.

Instead, I set Min and Max to correspond to an integer percentage (Min is set to 0; Max is set to 100). This lets File Hunter interpret the value returned by the scroll bar as a percentage that can be applied against the total number of files in the Hit List. If the user drags the scroll bar pointer halfway along the length of the scroll bar, for instance, File Hunter can apply a value of 50 percent against the number of records actually present. If this number is, say, one billion, then File Hunter knows that the first item in the list box will be 500,000,000.

In addition to mouse events, the virtual list box also has to respond to keyboard events. If the focus is set to the list box, I capture each key and determine whether it is a "navigation" event. Using this strategy, File Hunter is able to successfully process the Up Arrow, Down Arrow, PgUp, PgDn, Ctrl-Home, and Ctrl-End keyboard events.

The Visual Basic list box does not support a horizontal scroll bar, even if the text in the list box extends beyond the right border of the control. To solve this problem, I used the following SendMessage API call to activate the list box's horizontal scroll bar:

```
x& = SendMessage(lstHitList.hWnd, _
LB_SETHORIZONTALEXTENT, Me.TextWidth _
(Space$ (HIT_LIST_MAX_LEN)), NUL)
```


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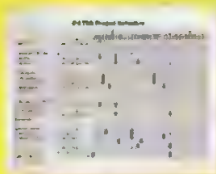
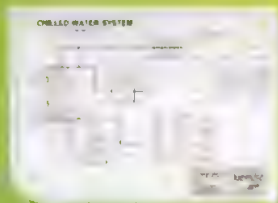
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This use of the `SendMessage()` function demonstrates that some controls have "hidden" functionality that can be activated with low-level tricks—in this case, a simple call to the Windows API. Every list box can display a horizontal scroll bar when its width is less than the value specified in an `LB_SETHORIZONTALEXTENT` message. The VB list box control doesn't expose this abil-

ity of the underlying Windows list box control. However, it does expose the window handle of the list box (the `hWnd` property). This makes it possible to send Windows messages to the list box and get at functionality that wasn't exposed by VB.

File Hunter will thoroughly and diligently hunt for all those files that you thought were lost forever in your forest

of drives and directories. And if you lose sight of File Hunter among your tangled assortment of icons, remember you can always launch it from the custom File Manager menu. □

JONATHAN WALDMAN IS A PROGRAMMER/ANALYST WHO WORKS AS A CONSULTANT IN THE WASHINGTON, DC, AREA. HIS COMPU-SERVE ID IS 72570,3135.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

FILE HUNTER

PURPOSE: File Hunter is an enhanced version of File Manager's search facility that can be launched from File Manager's main menu or from its Program Manager icon. It lets you search multiple drives and directories at once, and broadens the search criteria to include filename, date, time, size, and attributes.

USAGE: To install File Hunter, simply run its setup program (`SETUP.EXE`). This will place the two program files, `FILEHUNT.EXE` and `FMXTENDR.DLL`, in the sub-directory of your choice, install necessary Visual Basic system files in your Windows System directory, and (optionally) add File Hunter to your File Manager menu by modifying your `WINFILE.INI` file.

You can access File Hunter's basic features from the main screen. Just type in the starting directories for a search, separated by semicolons, and then type in the file mask. Checking on Include Subdirectories tells File Hunter to use the listed directories as starting points and to drill all the way down.

For other features, click the Advanced... button. The Directory Options view is presented first, and it lets you browse through your directory structure to find the directories you want to search. Switch to the File Mask Options view by clicking on the radio button.

FILES: `FHUNT.DOC`—just the documentation file.
`FHUNT.EXE`—a self-extracting compressed file that provides the executable and setup programs.
`FHUNT.ZIP`—the source code, program, and documentation files for FileHunter.

SUPPORT: Help for the free utilities offered by *PC Magazine* can be obtained electronically in the Utilities section of ZiffNet's Utilities/Tips forum (`GO ZNT:TIPS`). The authors of current utilities generally visit this forum daily. If the author is not available and the forum sysops can't answer your question, the Utilities column editor, who also checks this forum each day, will contact the author for you.

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Negative Requirements

❓ I have a large number of 35-mm photographic negatives; unfortunately I've lost most of the prints made from them. I wonder if there is a product that will scan negatives and display a positive image on screen. That would certainly be a lot easier than having prints made from all those negatives so I could then scan them.

*N. Caruncho IV
Manila, Philippines*

► **PC MAGAZINE:** The solution is probably simpler than you think. If you have a scanner that can handle transparencies, you almost certainly have what you need already. If not, you'll need to get either a transparency attachment for your scanner or a dedicated slide scanner, such as the ones from Polaroid and Nikon. Note that, depending on your scanner, you may need to cut up the negative and place the individual frames in slide mounts before scanning.

Once you have the negative scanned, you can let your computer "develop" the prints for you. All the graphics-editing programs I've checked have a feature that lets you invert the colors of your image. If you don't have this feature, you can add it inexpensively with a graphics utility such as ImagePals from U-Lead Systems. Inverting the colors will produce a positive image from your negative, and you'll be ready to work with the image.—*Alfred Poor*

Image Problem

❓ I have a VL-Bus graphics card with 1MB of memory and a 14-inch SVGA monitor. When I run Windows, the image is properly centered on the screen. But when I exit and go back to DOS, the

image shifts way over to the left and looks as if it's folded over. Is this a card or a monitor problem?

*Patrice Calve
via the Internet*

► **PC MAGAZINE:** There is probably nothing wrong with either your graphics adapter or your monitor, though the "problem" may require replacing the monitor. Although your letter doesn't mention it, I assume that you're running Windows at a higher resolution than the standard VGA's 640-by-480. The signals for different resolutions and different refresh rates have different timing patterns, and the monitor must synchronize with these signals in order to display the image. Small differences in signal timing will affect the image's size and position. Most monitors on the market are tuned at the factory to work with specific signal timings at different resolutions.

Your monitor probably has analog (as opposed to digital) controls, and it may therefore be limited in its ability to store settings for different resolution signals. A monitor with digital controls can store image size and position settings for different resolutions, so you can set the controls once for each resolution you use.

One solution would be to change the monitor, but there may also be a no-cost solution. Your graphics card presumably

has a configuration utility that lets you set the card for a specific monitor. If your monitor is not one of the listed models, you may have chosen one with similar characteristics. I suggest that you try setting up for a different monitor and see whether that has any effect; the card may use a different signal timing for different monitors. If this doesn't work, try changing the refresh rate for your Windows resolution. Decreasing it may bring the signal timing closer to what your monitor was tuned for at the factory.—*Alfred Poor*

Baffled by the Bus

❓ In PC Solutions for September 27, 1994, under the heading "Proprietary Problems," you wrote something I did not exactly understand: "Incidentally, the VL-Bus specification is designed to work with ISA, EISA, and Micro Channel motherboards." Does this mean that IBM PS/2 Micro Channel adapter cards can fit into a VL (local bus) motherboard, or that VL cards can fit into a PS/2 Micro Channel motherboard, or neither?

*David Raymond
via ZiffNet*

► **PC MAGAZINE:** Unfortunately, VL-Bus is not a miracle translator that lets you put Micro Channel cards into ISA slots or vice versa.

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PC DIRECT starts here with exciting offers from top direct vendors.

See index, page 344.

The VESA Local Bus (VL-Bus) specification covers a number of details, including the placement of the VL-Bus connector on a motherboard. The original intention was to create a flexible design that could be incorporated into any motherboard design. As a result, specifications were created that described the position of the connector for all three expansion buses used for PC-compatibles of the time. In practice, VL-Bus slots are found mostly on motherboards with ISA expansion slots, but in theory they can also be added to motherboards with EISA or Micro Channel slots. I've heard of a number of EISA VL-Bus motherboards, from American Megatrends and NEC, but I'm not aware of any Micro Channel VL-Bus motherboards.—*Alfred Poor*

Dizzy from SCSI

❓ I'm dazed and confused by the various kinds of SCSI boards available for the PC. What is the difference between SCSI and SCSI-2, and between Fast SCSI and Wide SCSI? Also, can you put two SCSI cards in one system?

*Hung Chu
Douglaston, New York*

HOW TO CONTACT US

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Our Advisors

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Craig Stinson is a contributing editor and coauthor of *Running Windows 3.1* and *Running Microsoft Excel*.

M. David Stone is a contributing editor and coauthor of *Word for Windows Companion, Second Edition*.

► **PC MAGAZINE:** I'm not at all surprised that you find all these SCSIs a bit confusing. The standards are changing, and it will take a lot of people time to get it all straight.

To begin with, SCSI stands for "small computer system interface." It is a parallel interface in that it uses multiple signal lines at one time—like a parallel printer cable—instead of the single pair of data lines used in a serial cable. The 8-bit data path has a maximum throughput of 5MB per second, which was severe overkill in the days when a 60MB hard disk was a valued treasure.

As computer systems grew in size and

speed, however, the original SCSI specification became a performance bottleneck. In response, the SCSI-2 specification was created. In fact, there are three versions of SCSI-2: Fast, Wide, and Fast/Wide.

Fast SCSI-2 supports data transfer rates at speeds up to 10MB per second—twice as fast as the original. Wide SCSI-2 supports either a 16- or a 32-bit-wide data path; increasing the size of the pipe to 32 bits means it can handle four times as much data as the original SCSI, or 20MB per second. Finally, the specification provides for devices that are both Fast and Wide, yielding a theoretical maximum transfer rate of 40MB per second.

To fully benefit from these added capacities, however, you must use devices that can take advantage of them. SCSI-2 is backward-compatible with SCSI devices, so just because a vendor tells you that a given hard disk will *work* with a SCSI-2 interface doesn't mean it will be any faster than if it were attached to a SCSI adapter. A plain-old SCSI device will not gain anything from being attached to a SCSI-2 controller.

As for whether you can install more than one SCSI controller in a single system, you can. And there may be good reasons to do this. For example, if you have a CD-ROM recorder, it will need its data delivered in an uninterrupted stream. If the transfer is halted for just an instant, the CD can be ruined. As a result, many CD-recorder manufacturers recommend that you install a separate hard disk with its own SCSI controller so it can transfer the full CD image in one chunk to the waiting recorder. In this way, any reads or writes to your main hard disk will not affect the data stream.—*Alfred Poor*

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★ USA Flex is becoming good at offering exceptionally fast PCs at affordable prices...the Flex DX4/100 Desktop: It not only outperformed most of its DX4-100 peers, it also kept pace with the average Pentium-66...Support policies are excellent...With this system, you get Pentium-level performance and solid multimedia for a great price.

-PC WORLD May 1995

★ "The PT90 from USA Flex comes preconfigured with a full set of multimedia hardware, a powerful 90MHz Pentium processor, and an impressive stack of CD-ROM software. In sum the PT90 is a gung-ho multimedia machine that has it all. No wonder it roared into our Power Desktops Top 20."

-PC WORLD May 1995

★ "Nothing's perfect, but some things come very close. One such thing is USA Flex's PT90 Quad Speed Multimedia Tower." "The system bundles a cornucopia of extras and great performance in a package that could well redefine the concept of a full-bodied multimedia environment."

-COMPUTER SHOPPER May 1995

★ The \$1,995 USA Flex Family Edition offers a welcome combination of processing power and quality multimedia accessories, making it a good bet for the den or the home office.

-PC MAGAZINE December 1994



A large computer system featuring a tower unit, a CRT monitor displaying an eagle, a keyboard, a mouse, a printer, and two large speakers. The background is decorated with large stars and stripes, reminiscent of the American flag.

**Flex
Ultimate
PT 100
Multimedia
Tower**

Soar with the Freedom of Choice you deserve. When we know what you need to do with your system, we can suggest proven components that will handle all your projects with ease. Your job or your business may be riding on your choice of computer system. You can't afford to spend a lot of time and money on the wrong system. If you KNOW what you need, we won't try to talk you into some "combo-of-the-month" that has a lot of add-ons that you DON'T want. USA FLEX can take the guess work out of buying a PC by matching and testing the components you need. We've been doing it for over 18 years so we know what works, and we stand behind every system with 24 hour service and warranties that are the standard of the industry.

A smaller computer system featuring a tower unit, a CRT monitor displaying a person on a yellow ball, a keyboard, a mouse, a joystick, and two small speakers.

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Family
Classic**

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 • PCI EIDE • 2 serial, parallel, game
 • 14.4/14.4 Data/Fax Modem • Internet Starter
 Kit • Trial subscriptions to America On-Line,
 Prodigy, CompuServe • Quad Speed CD-ROM
 Drive (Fast 600KB/s trans) • Wave Table 16bit
 Sound Card, SoundBlaster Compatible, Real
 Wave Table Sounds • Altec Lansing Stereo
 Speakers • w/bass, sub-woofers • Stereo
 Headphones, Joystick • 21 CD Titles (10 CD
 disks) • 15" Multiscan Color Monitor, .28dp
 1280x1024 (62KHz H-Scan) • DOS, Windows
 Microsoft Mouse, Microsoft S/W Package
 • Desktop Case w/7 drive bays • Accessory Kit
 • Hewlett-Packard DeskJet 540 Printer with color ink
 • 15" Multiscan Color Monitor, .28dp

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Includes Hewlett-Packard
 DeskJet 540 Printer and
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FLEX HOME/OFFICE SPECIAL

Intel 486DX4-100 Processor • 16MB RAM
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 w/1MB RAM, 16.7M colors @ 640x480 • 15"
 MultiScan Color Monitor, .28dp, 1280x1024
 (62KHz H-Scan) • EIDE I/O w/2 16550 serial,
 EPP/ECP parallel, game port • 14.4/14.4
 Data/Fax Modem • Trial subscriptions to
 America On-Line, Prodigy, CompuServe • EIDE
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 • Wave Table 16bit Sound Card, SoundBlaster
 Compatible, Real Wave Table Sounds
 • Amplified Stereo Speakers • Business Library
 on CD-ROM • DOS, Windows, Microsoft Mouse,
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 Drive Bays • 82 professional Monotype fonts
 • Epson ActionLaser 1100 Printer with printer
 cable • Internet Starter Kit • Accessory Kit

\$2495

Includes Epson
 ActionLaser 1100 Printer



FLEX 486 BASIC WORKSTATION

- Intel 486DX2-66MHz Processor
- Desktop Case with 7 drive bays
- 4MB RAM, (128MB maximum)
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- 1.44MB 3.5" Floppy Drive
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- Video Accelerator with 1MB DRAM, 16.7M colors @ 800x600
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- Genuine Microsoft Ergonomic mouse

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- 256K L2 W/B Cache
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- PCI EIDE, 2 serial, parallel, game
- 14.4/14.4 Data/Fax Modem
- Internet Starter Kit
- Trial subscriptions to America On-Line, Prodigy, CompuServe
- Quad Speed CD-ROM Drive (Fast 600KB/s trans)
- Award-Winning 16bit Wave Table SoundBlaster Compatible Sound Card with 2MB Wave Table for Outstanding Stereo Sound
- Altec-Lansing Stereo Speakers w/bass sub-woofer
- Stereo Headphones, Joystick
- 14 CD Titles (6 CD disks)
- 17" Color Monitor, 28dp, 1280x1024NI (65KHz H-Scan)
- DOS, Windows, Microsoft Mouse, Microsoft S/W Package
- Premium Tower Case w/10 drive bays
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- 850MB EIDE compatible HD
- 1.44MB 3.5" Floppy Drive
- 256K L2 W/B Hi-Speed Cache
- Quad speed EIDE CD-ROM drive
- 64bit PCI video accelerator with full 2MB DRAM, 16.7M colors @ 800x600
- 15" Multiscan color monitor, 28dp, 1024x768 @ 75Hz NI (62KHz horizontal scan rate)
- 2 Hi-Speed 16550 serial ports and 1 EPP/ECF parallel port
- 101 Key enhanced style keyboard
- MS-DOS v6.22 with manuals and diskettes
- MS-Windows for Workgroups with manuals and diskettes
- Genuine Microsoft Ergonomic mouse

\$1999 Business Lease**
*75"/month

Add a 14.4/14.4 data/fax modem, only \$79*

FLEX PT90 BUSINESS WORKSTATION

As above, with the following upgrades: Intel Pentium 90MHz Processor, 1.0GB EIDE compatible HD

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Add a 16bit sound card with wave table sound and 16 watt powered speakers, only \$129*

FLEX PT120 HIGH PERFORMANCE WORKSTATION

- Intel Pentium 120MHz Processor
- Mid-Tower Case with 6 drive bays
- 16MB RAM, (128MB maximum)
- 1.2GB EIDE compatible HD
- 1.44MB 3.5" Floppy Drive
- 256K L2 W/B Hi-Speed Cache
- Quad speed EIDE CD-ROM drive
- 64bit PCI video accelerator with full 2MB DRAM, 16.7M colors @ 800x600
- 17" Multiscan color monitor, 28dp, 1600x1280 @ 60Hz NI (85KHz horizontal scan rate)
- 2 Hi-Speed 16550 serial ports and 1 EPP/ECF parallel port
- 101 Key enhanced style keyboard
- MS-DOS v6.22 with manuals and diskettes
- MS-Windows for Workgroups with manuals and diskettes
- Genuine Microsoft Ergonomic mouse

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- 850MB EIDE HD
- 256K L2 W/B Cache
- 1.44MB 3.5" Floppy Drive
- 64bit Video Accelerator w/2MB RAM, 16.7M colors @ 800x600
- EIDE-I/O w/2 serial, parallel, and game port
- 14.4/14.4 Data/Fax Modem
- Trial subscriptions to America On-Line, Prodigy, CompuServe
- Sony CD-ROM drive (Double Speed 300KB/s trans)
- Wave Table 16bit Sound Card, SoundBlaster Compatible, Real Wave Table Sounds
- Amplified Stereo Speakers
- Stereo Headphones, Joystick
- 19 CD Titles (5 CD Disks)
- 15" Multiscan Color Monitor, 28dp, 1280x1024 (62KHz H-Scan)
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- Desktop Case w/7 Drive Bays
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- 1.2GB EIDE compatible HD
- 1.44MB 3.5" Floppy Drive
- 256K L2 W/B Hi-Speed Cache
- Quad speed EIDE CD-ROM drive
- 64bit PCI video accelerator with full 2MB DRAM, 16.7M colors @ 800x600
- 17" Multiscan color monitor, 28dp, 1280x1024 @ 60Hz NI (65KHz horizontal scan rate)
- 2 Hi-Speed 16550 serial ports and 1 EPP/ECF parallel port
- 101 Key enhanced style keyboard
- MS-DOS v6.22 with manuals and diskettes
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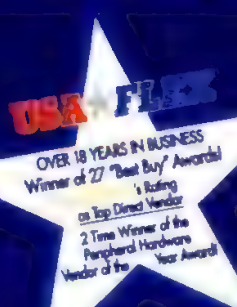
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- Intel Pentium 120 Processor
- 32MB RAM
- 1.2GB EIDE HD
- 256K L2 W/B Cache
- 1.44MB 3.5"/1.2MB Dual Floppy Drive
- PCI 64bit Video Accelerator w/2MB RAM, 16.7M colors @ 800x600
- PCI EIDE, 2 serial, parallel, game
- 14.4/14.4 Data/Fax Modem
- Internet Starter Kit
- Trial subscriptions to America On-Line, Prodigy, CompuServe
- Quad Speed CD-ROM Drive (Fast 600KB/s trans)
- Award-Winning 16bit Wave Table SoundBlaster Compatible Sound Card with 2MB Wave Table for Outstanding Stereo Sound
- Altec-Lansing Stereo Speakers w/bass sub-woofer
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- 14 CD Titles (6 CD disks)
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- DOS, Windows, Microsoft Mouse, Microsoft S/W Package
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- 4MB (64MB max)
- 87 fonts
- 1 year On Site warranty

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Optra Lx

The high-performance, full-function LAN printer for large workgroups.

- 8ppm @ 1200dpi
- 16 ppm @ 600dpi
- 4MB (64MB max)
- 87 fonts
- 1 year On Site Warranty

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Optra LxL

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- 87 fonts
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ⓈCIRCLE 035 ON READER SERVICE CARD.

CODE #PM07A5

OPERATING ENVIRONMENTS

Comparing Dates in a Batch File

❓ I'm trying to write a batch file that compares the system date with a specific date I assign in the batch file. I want to say, for example, that if the system date is greater than a specific date do this, or else do that. I've tried my best but I can't seem to get this to work. I would appreciate your help in solving this problem.

Ahmed Elsale
Brooklyn, New York

```
@ECHO OFF
REM CMPDATE.BAT - Compare current date to date specified
REM in first parameter. Sets environment variable Compare
REM to Less, Greater, or Equal
IF NOT '%3'=='' GOTO SecondTime
REM Get the current date from the PROMPT
ECHO @PROMPT %0 $d %1 > CMP$$.BAT
REM DO NOT substitute CALL for COMMAND /C in next line
COMMAND /E:512 /C CMP$$.BAT > CMP$$.BAT
CMP$$.BAT
```

```
:==== SecondTime ====
DEL CMP$$.BAT
SET Compare=Equal
REM %2 is system date, %3 is user-specified date
IF '%2'=='%3' GOTO End
REM File date of CMP$$.BAT is system date
ECHO SET Compare=Greater>CMP$$.BAT
DATE %3
REM File date of CMP$$.BAT is user-specified date
ECHO SET Compare=Less>CMP$$.BAT
DATE %2
DIR CMP$$.BAT /O:D /B > CMP$$.BAT
CALL CMP$$.BAT
DEL CMP$$.BAT
:End
```

```
ECHO %3 %Compare% than %2 (today)
```



Figure 1: CMPDATE.BAT sets the variable Compare to indicate whether the passed date is Less than, Greater than, or Equal to today's date.

► **PC MAGAZINE:** CMPDATE.BAT (Figure 1) shows one approach to the problem. You pass it a date in the format that your DOS setup uses (usually MM-DD-YYYY). The batch file sets the environment variable Compare to *Less* if the passed date is less than the system date; to *Greater* if it's greater; and to *Equal* if it's precisely equal. This will work for any date that's valid as a DOS file date stamp

(the years from 1980 to 2099). For example, if the current date is 01-26-1995, the command `CMPDATE 01-01-1995` will set Compare to Less.

The central part of CMPDATE.BAT involves creating two temporary batch files, `CMP$$.BAT` and `CMP$$.BAT`. CMPDATE manipulates the DATE command so that one file's date stamp is today's date, and the other's is the date for comparison. It then uses DIR to create yet another temporary batch file containing the `_names_` of the two files, sorted by date. When this final temporary batch file runs, only its first line gets executed, and that line sets the environment variable Compare to the proper value. All that remains is to clean up the leftover temporary files.

This may seem like a lot of work, but DOS doesn't include any comparison operators. The IF test can tell that two strings are not equal, but it says nothing about which is greater. This batch

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2742	EISA	YES	MICROSCSI 50 PIN	339⁹⁵
2940	PCI	NO	MICROSCSI 50 PIN	289⁹⁵
Bus Logic				
540CF	ISA (AT)	NO	CENTRONICS 50 PIN	\$199⁹⁵
545C	ISA (AT)	YES	MICROSCSI 50 PIN	229⁹⁵
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120-Meter	19 ⁹⁵	18 ⁹⁵	17 ⁹⁵	3010XLF (8.50MB)	26 ⁹⁵	24 ⁹⁵	23 ⁹⁵
DAT Headcleaner	11 ⁹⁵	10 ⁹⁵	9 ⁹⁵	3080XLF (HyperTape)	34 ⁹⁵	32 ⁹⁵	31 ⁹⁵
SYQUEST MEDIA	1-4	5-9	10+	DC-2000 Cleaning Kit	17 ⁹⁵	16 ⁹⁵	15 ⁹⁵
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[illegible]

CIRCLE 052 ON READER SERVICE CARD

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APS Q 540²	Quantum 516MB	199⁷⁵	299⁷⁵
APS Q 730²	Quantum 699MB	249⁷⁵	349⁷⁵
APS Q 840²	Quantum 811MB	299⁷⁵	399⁷⁵
APS Q 1080⁵	Quantum 1042MB	349⁷⁵	449⁷⁵
APS ST 1.0⁵	Seagate 1010MB	549⁷⁵	649⁷⁵
APS Q 1.0⁵	Quantum 1025MB	699⁷⁵	799⁷⁵
APS Q 2.0⁵	Quantum 2050MB	999⁷⁵	1099⁷⁵
APS MS 2.0⁵	Micropolis 1955MB	999⁷⁵	1099⁷⁵
APS ST 2.0⁵	Seagate 2047MB	999⁷⁵	1099⁷⁵
APS MS 4.0⁵	Micropolis 4095MB	1399⁷⁵	1499⁷⁵
APS ST 4.0⁵	Seagate 4094MB	1499⁷⁵	1599⁷⁵
APS Q 4.0⁵	Quantum 4101MB	1499⁷⁵	1599⁷⁵
APS MS 9.0⁵	Micropolis 8649MB	2299⁷⁵	2499⁷⁵

DRIVES	EXTERNAL
APS T 3601 ¹	Good Sound \$349 ²

DRIVES	FORMATTED CAPACITY	DRIVE PRICE	EXTERNAL
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APS DAT ²	4GB	749 ^{ns}	799 ^{ns}
APS HyperDAT ²	8GB†	949 ^{ns}	999 ^{ns}
APS DLT20 ²	20GB†	—	3999 ^{ns}

f 2.1 Software data compression f 2.1 Hardware data compression

DRIVES	FORMATTED CAPACITY		EXTERNAL
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APS 1.3 MO²	Sony	124mb New 4MB cache	1999^{ms}

1-5 Denotes length of manufacturer's warranty

DRIVES	FORMATED CAPACITY	EXTERNAL
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MOBIStor Tape250²	250MB*	129⁹³
MOBIStor 340¹††	340MB	399⁹³
MOBIStor 520¹††	520MB	599⁹³
MOBIStor SyQuest¹	270MB	499⁹³
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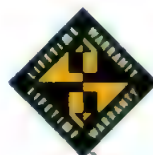
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230 MB IDE	M2512	30ms	525	n/a
230 MB PC	DynaMo*	30ms	n/a	985
230 MB	DynaMo*	30ms	n/a	885
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Milwa 4	4.2 GB	SCSI	9ms	5400	512K	1260
Barracuda	2.4 GB	SCSI	8ms	7200	1024K	955
Barracuda	4.2 GB	SCSI	8ms	7200	1024K	1429
Barracuda II	2.4 GB	SCSI	8ms	7200	1024K	995
Barracuda II	4.2 GB	SCSI	8ms	7200	1024K	1519
Elite	9 GB	SCSI	11ms	5400	512K	2850
ST3491A	420 MB	IDE	14ms	3800	256K	165
ST3660A	540 MB	IDE	14ms	3800	256K	175
ST3760A	720 MB	IDE	12ms	4500	256K	235
ST3850A	850 MB	IDE	12ms	4500	256K	245
ST31220A	1.0 GB	IDE	12ms	4500	256K	339

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CONNER

Model	Capacity	Interface	Seek	RPM	Cache	Int.
CFP1080	1.08 GB	SCSI	10ms	5400	256K	475
CFP2105	2.0 GB	SCSI	8.5ms	5400	512K	885
CFP2107	2.1 GB	SCSI	8.5ms	5400	512K	985
CFP4105	4.0 GB	SCSI	8.5ms	5400	512K	1569
CFS425	425 MB	IDE	10ms	5400	256K	170
CFA540	540 MB	IDE	8.5ms	5400	512K	195
CFA850	850 MB	IDE	8.5ms	5400	512K	255
CFA1275	1.0 GB	IDE	8.5ms	5400	512K	385

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Quantum

Model	Capacity	Interface	Seek	RPM	Cache	Int.
Trailblazer	420 MB	IDE/SCSI	11 ms	4500	128K	185/185
Fireball*	540 MB	IDE/SCSI	10 ms	5400	128K	205/220
Lightning	730 MB	IDE/SCSI	11 ms	4500	128K	245/245
Trailblazer	850 MB	IDE/SCSI	11 ms	4500	128K	250/270
Fireball*	1080 MB	IDE/SCSI	10 ms	5400	128K	355/475
Atlas	2.1 GB	SCSI	9 ms	7200	1024K	920
Grand Prix	4200 MB	SCSI	8.6 ms	7200	512K	1195
Atlas	4.3 GB	SCSI	9 ms	7200	1024K	1515

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M1936	3.6 GB	SCSI	11 ms	5400	512K	1225
M43243	4.3 GB	SCSI	8.5 ms	7200	512K	1325
M1891	9.0 GB	SCSI	11 ms	5400	512K	2170
M4221W	2.1 GB	SCSI	8.5 ms	7200	512K	1035
M43243W	4.3 GB	SCSI	8.5 ms	7200	512K	1455
M1991W	9.0 GB	SCSI	11 ms	5400	512K	2270
M4221AV	2.1 GB	SCSI	8.5 ms	7200	512K	985
M1836AV	3.6 GB	SCSI	11 ms	5400	512K	1275
M3243AV	4.3 GB	SCSI	8.5 ms	7200	512K	1425
M1991AV	9.0 GB	SCSI	11 ms	5400	512K	2285
M4221WAV	2.1 GB	SCSI	8.5 ms	7200	512K	1085
M3243WAV	4.3 GB	SCSI	8.5 ms	7200	512K	1525
M1991WAV	9.0 GB	SCSI	11 ms	5400	512K	2395

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FUJITSU

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M1806	1.0 GB	SCSI	10ms	5400	512K	495
M2915	2.1 GB	SCSI	10ms	5400	512K	945

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CONNER

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Mountain

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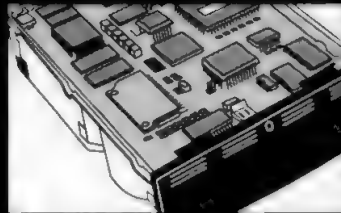
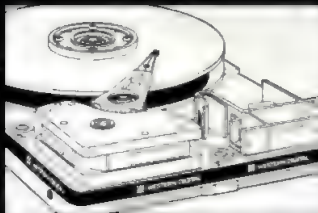
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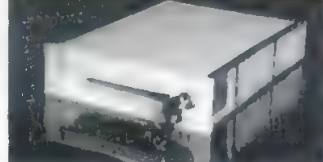
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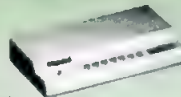
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file takes advantage of one of the few comparisons DOS does perform: sorting the output of the DIR command.

—Neil J. Rubenking

No Sound—Some Fury

I use Windows 3.1 and a Creative Labs SoundBlaster Pro card in a 486/33 computer, with Program Manager as the shell. I've never been able to get the system

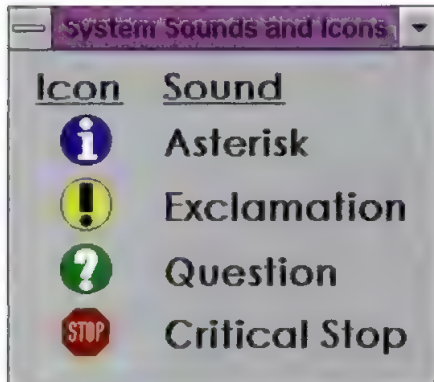


Figure 2: Four of Windows' system sounds are associated with these four standard message box icons.

sounds that are enabled and assigned to events in Control Panel to work, except for the opening, closing, and default sounds. The .WAV files all play when I test them, but not when I'm actually working in Program Manager or File Manager, though they sometimes work in other applications. If I use Norton Desktop as the shell, the system-event sounds do work, but I have too many conflicts with Norton that I don't have with Program Manager.

I also tried Wired For Sound and Sound Explosion, with the same results. The Sound Explosion technicians told me that whether the sounds work depends on the application in use. But Program Manager and File Manager are integral parts of Windows—shouldn't the sounds work when I use them? Is there something I can do to get these sounds to play—it's really upsetting me!

Dorothy A. Hodges
via ZiffNet

►PC MAGAZINE: You've accurately described Windows' normal handling of system sounds. The opening, closing, and default sounds are played automatically; the

other four standard sounds are not.

Here's what's happening. The standard message box in Windows displays one of four different icons, depending on the message type. Four of the Windows system sounds are also associated with different message types. Figure 2 shows the four icons and associated system sounds. You'd expect that when Windows displays a standard message box, it would automatically play the associated sound. But, as you've discovered, that's not the case. Programs must make an explicit function call to play the sound and, amazingly enough, Program Manager and File Manager, along with just about every Windows-supplied program, fail to make that call.

The Wired For Sound utility you mentioned adds sound to system events in a completely different way. When Wired For Sound is running, it detects these four particular message box types and automatically plays the associated sound. If you turn off Windows' internal handling of system sounds and run Wired For Sound instead, you should get sounds on all the standard system events and many more. Wired For Sound Pro is \$59.95 from Aristo-Soft, 510-426-5355.

—Neil J. Rubenking

WORD PROCESSING

Protecting WordPerfect Template Files

✎ I've created a large number of template files in WordPerfect 6.0 for DOS that serve as forms I can retrieve and fill in with variable information. Unfortunately, I have a bad habit of resaving template documents with unwanted information in them. I could make the files read-only, but removing the read-only attribute is a

```
DISPLAY(Off!)
fileext=substr(?name,-3;3)
If (fileext=".TPL")
  Filesavedlg
Else
  Save
endif
```



Figure 3: This WordPerfect 6.0a for DOS macro will help remind you not to overwrite template files with filled-in versions. The macro always opens the File Save As dialog box when saving .TPL files and gives you a chance to change the filename.

hassle if I do have to change the form. A better approach is a macro that helps remind me to rename the files when I save them.

To create the macro, hit Ctrl-F10, then type in a macro name or hit a shortcut

```
DISPLAY(Off!)
fileext=substr(?name,-3;3)
If (fileext=".TPL")
  Beep
  Display (On!)
  Prompt("WARNING: TEMPLATE FILE!!!
  You may want to change the name.")
  Wait(20)
  Filesavedlg
Else
  Save
endif
```



Figure 4: This macro builds on the version in Figure 3 by adding a beep and a reminder on the status line.

key, such as Alt-S. Make sure the Edit Macro box is checked and choose OK to edit the macro. Enter the commands shown in Figure 3, choose File Close, and answer Yes when WordPerfect asks whether to save the file.

The macro assumes that all your template files use a .TPL extension to identify them. It first creates a variable, Fileext, and sets it to match the last three letters of the filename for the current document window. The If command tests the value of Fileext. If the file has a .TPL extension, the macro goes to the Filesavedlg statement and quits. This opens WordPerfect's filesave dialog box so you can change the name. For all other files—including new documents that haven't been saved yet—the macro branches to the Save statement. If the file already has a name, you simply re-save it. If it doesn't have a name, WordPerfect will open the Save As dialog box so you can name it.

William Hopkins
Marble Hill, Missouri

►PC MAGAZINE: This is a straightforward solution to the inevitable annoyance of accidentally overwriting template files. All it requires is that you name your template files consistently and get in the habit of always saving by way of the macro. I've embellished the original a bit in Figure 4 by adding a beep and a warning message, making it even less likely that you'll accidentally overwrite the original template.

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- (1) Based on in-house testing; an average of three passes. Add two (2) additional points if EDO DRAM is used.
- (2) PC Magazine article, May 30, 1995

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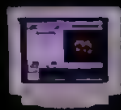
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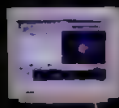
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You can find both macros on ZiffNet, as SAVE1.WPM and SAVE2.WPM.

If you use the macro in Figure 4 to save a file with a .TPL extension, the macro will beep and show a message in the status line warning that you're saving a template file and suggesting that you change the name. After a short pause, the macro will open the Save As dialog box.

Adding the warning requires four commands. The Beep and Prompt commands are self-explanatory, but you must also set the Display to on before the Prompt command or you won't see the message. In addition, I've added a Wait command after the prompt to add a delay between the time the warning shows in the status line and when the Save As dialog box appears. The Wait time is given in tenths of a second, so Wait(20) translates to 2 seconds. That should be enough to allow you to notice the message, but you may adjust the time if necessary.

—M. David Stone

■ DATABASES

Displaying a Progress Thermometer in FoxPro

TIP I've seen several utilities that display a thermometer bar in Microsoft FoxPro to indicate progress during processing. Recently I discovered how to avoid reinventing the wheel: Just use the thermometer procedures built into the FoxPro GENXTAB program! Figure 5 shows a short section of code that demonstrates this technique. Note that I specify the location of the GENXTAB program by using the system variable _GENXTAB. That way you don't have to worry about where the GENXTAB program is located.

Gary Tatum
College Station, Texas

► **PC MAGAZINE:** As Mr. Tatum discovered, GENXTAB contains several thermometer routines that you may find useful in your own FoxPro pro-

grams. FoxPro uses GENXTAB, which comes with your copy of FoxPro, to output RQBE (relational query by example) results in crosstab format.

You can usually find it in the directory where you installed FoxPro.

The progress thermometer shown in Figure 6 keeps the user informed during a long-running procedure by graphically indicating how much of the process is completed. First you call the acttherm procedure to create the thermometer window and activate it on the display. You should pass it a text string such as "Processing..." or "Updating..." or some other informative text. The string is displayed just above the progress indicator. You must initialize the public variable g_thermwidth prior to calling the routine.

Then, once the thermometer is displayed, you update it periodically by calling the updtherm procedure. You must pass this routine a value in the range of 0 to 100. The value represents a completion percentage.

Finally, when your processing completes (the thermometer has reached 100), you can remove the window by calling the deactthermo routine.

The _GENXTAB system variable holds the full path specification of the program that FoxPro calls to output RQBE results in crosstab format. The default is

Performing database maintenance...

Figure 6: You can add this thermometer bar to your own FoxPro programs using the routines found in FoxPro's GENXTAB.PRG program.

the GENXTAB.PRG program provided with FoxPro. For example, on my system _GENXTAB contains "C:\FPW26\GENXTAB.PRG." But you can substitute a different program by changing the _GENXTAB system variable.

Mr. Tatum uses the DO...IN (_GENXTAB) syntax to avoid having to specify the location of the GENXTAB.PRG program. As long as _GENXTAB correctly points to the GENXTAB.PRG that contains the thermometer routines, this will work fine.

Note, however, that the program name is stored in a system memory variable so that you can easily change it and plug in your own replacement for FoxPro's GENXTAB.PRG program. If you do that and you forget about the thermometer routines, and your replacement doesn't have the same thermometer routines, you'll break the code in Figure 5.

There's also no guarantee that Microsoft will include the same or any thermometer routines in new versions of GENXTAB. If it doesn't, updating to a new release of FoxPro or GENXTAB might break the code in Figure 5. All things considered, it's better to avoid

using the DO...IN syntax and instead place the thermometer routines directly into your own program or project, where they'll always be safely available and ready to be called.

According to a Microsoft representative, you can freely copy the thermometer routines in GENXTAB.PRG to your own programs. You'll need to copy the #DEFINE for c_dlgface, c_dlgsize, and c_dlgstyle too, as these are used often in the acttherm procedure. □

—Sal Ricciardi

```
.....
* How to use the FoxPro thermometer routines in GENXTAB
.....
* Initialize the g_thermwidth variable used by updtherm
g_thermwidth = 80

* Initialize the window procedure with your desired prompt
DO acttherm IN (_GENXTAB) WITH "Processing..."

ctr = 1          && Initialize a memvar for record counter

SCAN            && Or start other processing loop
                && Update bar

    DO updtherm IN (_GENXTAB) WITH ctr/RECCOUNT()*100

                && Any other processing goes here

    ctr = ctr + 1 && Update memory variable
ENDSCAN

DO deactthermo IN (_GENXTAB) && Removes thermometer window
```

Figure 5: Sample code that displays and updates a progress thermometer using the thermometer routines provided in FoxPro's GENXTAB program.



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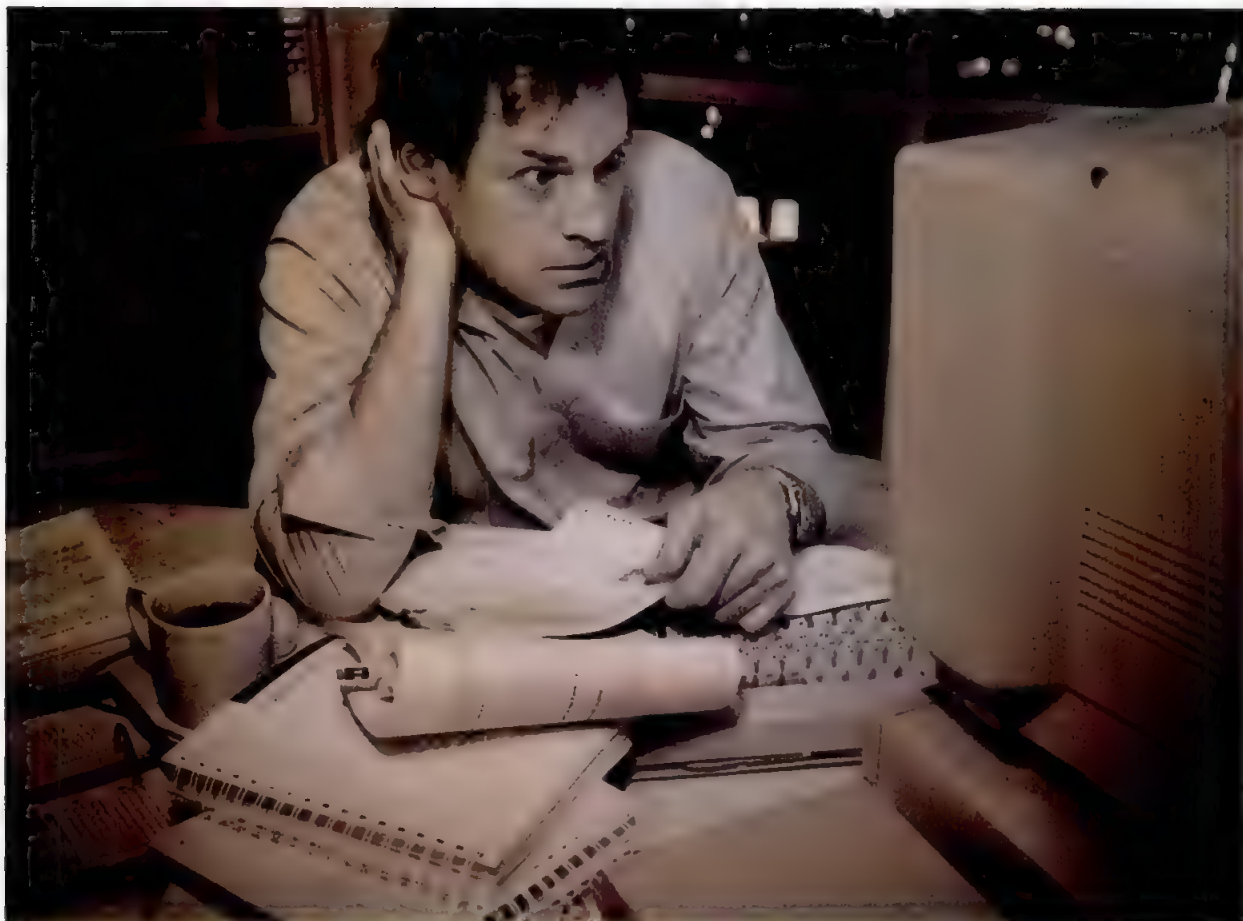
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8087-2	45.00	45.00	45.00	45.00
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8087-2	45.00	45.00	45.00	45.00
8087-1	45.00	45.00	45.00	45.00
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1Meg x 9 (9 chips)	-	40.00	40.00	40.00	40.00	40.00
4Meg x 9	-	154.00	154.00	154.00	154.00	154.00
16Meg x 9 (9 chips)	-	-	-	-	-	-

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	4096	8096	16096	32096	64096	128096
226 x 9	-	-	-	-	-	-
1Meg x 9 (1 chip)	-	40.00	40.00	40.00	40.00	40.00
1Meg x 9 (9 chips)	-	40.00	40.00	40.00	40.00	40.00
4Meg x 9	-	154.00	154.00	154.00	154.00	154.00
16Meg x 9 (9 chips)	-	-	-	-	-	-

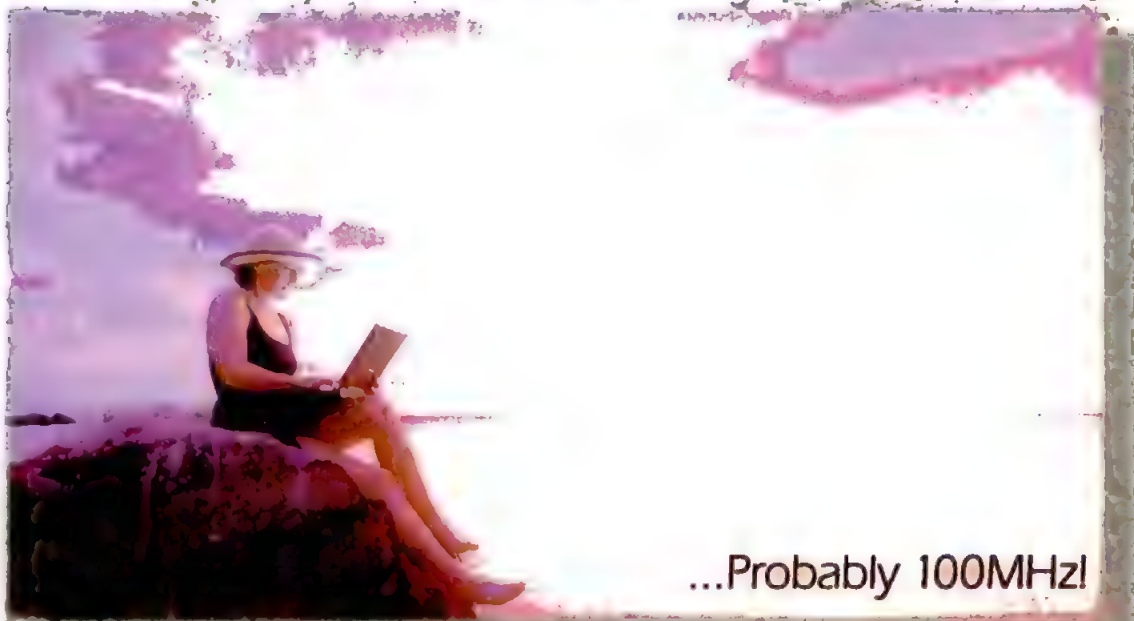
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- 10.4" DSTN Color
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Product	Code	Product	Code
Pentium PowerBrick	1485	ThunderBrick Desktops	1785
Big ScreenNoteBrick	1285	SubBrick	1185
CD-Brick	2185	All Products Summary	1685

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- MS-DOS, UltraFont, Indeo video compression software, Windows for Workgroups 3.11 and Run Time for Windows



Model	Processor	Ram	Screen	Hard Drive	Price
T4800CT	486DX3/75	8MB	9.5" Active	500MB	\$3102
T4850CT	486DX4/75	8MB	10.4" Active	520MB	\$3273
T4850CT	486DX4/75	8MB	10.4" Active	772MB	\$3443

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- Built-in double speed CD-ROM drive
- SoundBlaster Pro compatible sound support
- Integrated AccuPoint Pointing Device
- VL Bus local bus video
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New!



Model	Processor	Ram	Screen	Hard Drive	Price
T2100	486DX2/50	4MB	9.5" Mono	250MB	\$1393
T2100CS	486DX2/50	4MB	10.4" Dual Scan	330MB	\$2162
T2100CT	486DX2/50	8MB	8.4" Active	330MB	\$2675
T2150CDS	486DX4/75	4MB	10.4" Dual Scan	500MB	\$3059
T2150CDT	486DX4/75	8MB	10.4" Active	500MB	\$3657
T2400CS	486DX2/50	4MB	9.5" Dual Scan	250MB	\$2031
T2400CS	486DX2/50	4MB	9.5" Dual Scan	320MB	\$2159
T2450CT	486DX4/75	8MB	8.4" Active	320MB	\$3102

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4MB Memory Upgrade	\$172
8MB Memory Upgrade	\$335
16MB Memory Upgrade	\$679
Extra Battery Pack	\$134

T4900CT

- 75MHz Mobile Pentium Processor
- 8MB RAM expandable to 40MB
- 772MB hard drive
- 10.4" active matrix color display
- 1 Type II and 1 Type III PCMCIA slots
- Accupoint integrated pointing device
- MS-DOS 6.21, Windows for Workgroups 3.11, Windows sound System 2.0, Indeo Video, and Run Time Video for Windows.



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ASCENTIA 910N

- 486 50Mhz or 75Mhz processor
- 2 Type II PCMCIA slots or 1 Type III PCMCIA slot
- Removable disk drive
- Dual Scan or active matrix color screen

Processor	Ram	Screen	Hard Drive	Price
486DX2/50	8MB	10.3" Dual Scan	340MB	\$2420
486DX4/75	8MB	10.3" Dual Scan	510MB	\$2606
486DX4/75	8MB	10.4" Active	510MB	\$3631
486DX4/75	8MB	10.4" Active	700MB	\$3910
486DX4/75	8MB	10.3" Dual Scan	700MB	\$CALL

ASCENTIA 810N

- 486/66Mhz processor
- Dual battery capability
- 10.4" DualScan STN color display

Processor	Ram	Screen	Hard Drive	Price
486DX2/66	4MB	10.4" Dual Scan	250MB	\$1862
486DX2/66	4MB	10.4" Dual Scan	340MB	\$2002
486DX2/66	4MB	10.4" Dual Scan	510MB	\$2141



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- 4MB expandable to 20MB
- 2 Type II PCMCIA slots or 1 Type III PCMCIA slot
- MS-DOS 6.21, Windows 3.1, built-in trackball
- Removable hard drive
- Removable floppy - add second battery

Processor	Ram	Screen	Hard Drive	Price
486DX2/50	4MB	9.5" Dual Scan	250MB	\$2188
486DX2/50	4MB	9.5" Dual Scan	340MB	\$2327
486DX2/50	4MB	9.5" Active	250MB	\$2327
486DX2/50	4MB	9.5" Active	340MB	\$2560
486DX2/50	4MB	9.5" Active	540MB	\$2840
486DX2/50	4MB	10.1" Active	340MB	CALL
486DX4/75	4MB	10.1" Active	540MB	CALL
486DX4/75	4MB	9.5" Active	340MB	\$2747
486DX4/75	4MB	9.5" Active	540MB	\$3026

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- Upgradable hard drive
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- Full color with over 65,000 colors

Processor	Ram	Screen	Hard Drive	Price
486DX4-75	8MB	9.5" Dual Scan	250MB	\$2997
486DX4-75	8MB	9.5" Active	340MB	\$3678
486DX4-100	8MB	9.5" Active	340MB	\$4003
486DX4-100	8MB	9.5" Active	810MB	\$4655

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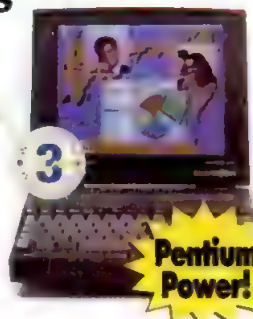
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4000M	486DX2/50	4MB	8.4" Active	455MB	\$2343
4000M	486DX4/75	4MB	9.5" Dual Scan	455MB	\$2427
4000M	486DX4/75	4MB	8.4" Active	340MB	\$2678
4000M	486DX4/75	4MB	8.4" Active	455MB	\$2930
4000M	486DX4/100	4MB	9.5" Active	525MB	\$3850
5000M	Pentium 75Mhz	8MB	10.5" Dual Scan	500MB	\$4939
5000M	Pentium 75Mhz	8MB	10.4" Active	772MB	\$5525



Pentium Power!

NEC VERSA P

- 75Mhz Mobile Pentium Processor
- Built-in 16-bit sound, microphone & speaker

Processor	Ram	Screen	Hard Drive	Price
Pentium 75Mhz	8MB	9.5" Active	340MB	\$4282
Pentium 75Mhz	8MB	10.4" Active	540MB	\$4934

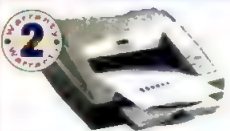


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DECwriter 500i, 5PPM, 500x300 Dots	\$270
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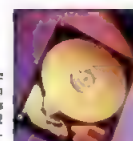
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NEC

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HP LaserJet 11P 11T 11HP 11TD	2MB 33475B	\$95	4MB 33477B	\$169
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IBM/Lexmark Laser 4029 (all models)	2MB 1183334	\$87	4MB 1183335	\$157
IBM/Lexmark Laser 4039, 4079 (all models)	4MB 1328361	\$157	8MB 1328365	\$319
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Okidata 400e, 410e	2MB n/a	\$117	4MB n/a	\$197
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Panasonic LaserPartner 4410, 4430	2MB KX-P444	\$115	4MB n/a	\$196
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Texas Instruments MicroLaser, XL	1MB 2555739-0001			\$49

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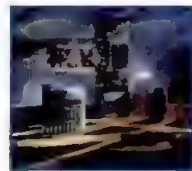
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Premium 386/33T, 386SX/16 and Premium II 386SX/20, 25	4MB 500780-004	\$188		
Advantage! 486/25, 33, 33e, Premium Server SE 4/33	Pro Premium and Premium TE all models			
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	4MB 141684-001	\$153		
	8MB 141685-001	\$307		
DeskPro 386-20, 25, 385-20e, 25e	1MB Module	113131-001	\$62	
	4MB Module	113132-001	\$167	
DeskPro 386/16	1MB Module	113646-001	\$62	
	4MB Module	112534-001	\$194	
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DeskPro 3/25e, 33i, 4/25e, 33e, 66i, 286N, 386N, SX/20, 20N, SystemPro LT and M Series	1MB 118688-001	\$49	2MB 118689-001	\$95
	4MB 118690-001	\$153	8MB 118877-001	\$356
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	4MB 6450128	\$169
	8MB 6450130	\$356
PS/2 80-111; 111; 121; 321; 081, 161	2MB 6450879	\$88
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	2MB Board OP410-8102+8103			\$171
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Vectra 386/16N, 20N; 25N models	2MB D2406A	\$89	8MB D2404A	\$305
Vectra 486 M, MI, N, NI and XM models	2MB D2381A	\$95	8MB D2152A	\$305
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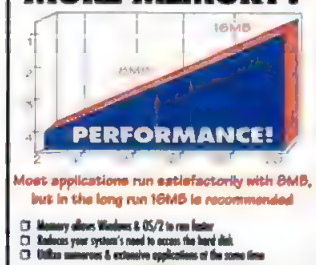
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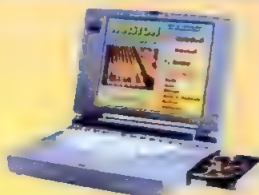
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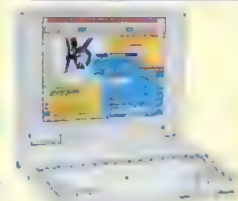
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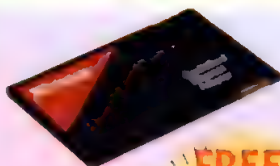
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LQ-300	normal	24	\$194.78	
LQ-570+	normal	24	\$245.40	
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600 dpi quality at a personal price

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True 720 dpi!

- ✓ Selectable print resolutions: 720 x 720 dpi, 360 dpi, or 180 dpi
- ✓ Color print speed, highest quality mode: 5.5 min/page
- ✓ Nozzles: 64 black, 48 color
- ✓ Emulation: ESC/P2 Color
- ✓ 5 bitmap fonts, 4 scalable fonts
- ✓ 64KB input buffer
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- ✓ Cartridge life (characters): black 1.5 million/color 1.2 million
- ✓ Parallel and serial interface

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Okidata OL410e High-resolution LED page printer

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- ✓ HP PCL5 emulation, 12 scalable fonts
- ✓ High-performance 16MHz MIPS 3000 RISC-based CPU for fast print job processing
- ✓ Reliable solid-state LED printhead, 5 year printhead warranty
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- ✓ 100 sheet paper tray, adjustable manual feed for legal and envelopes

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- ◆ 300 dpi resolution
- ◆ 512KB RAM with 2X effective memory compression
- ◆ 32-bit RISC CPU for fast print job processing
- ◆ HP PCL4 emulation, 44 bitmap fonts
- ◆ Parallel and serial interfaces: auto-switching
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- ◆ Low power consumption, EPA Energy Star compliant
- ◆ Warranty: 8 years on LED printhead, 1 year parts and labor

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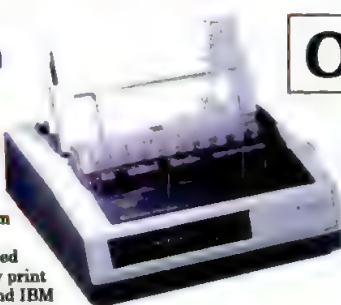
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CDW 30968

ML590 and ML591 24-pin printers

A reliable and versatile choice for business needs

- ✓ 24 pin dot matrix impact printer
- ✓ 360 x 360 dpi maximum graphics resolution
- ✓ 120 cps maximum letter quality print speed
- ✓ 450 cps maximum draft quality print speed
- ✓ Emulation: Epson LQ and IBM XL 24E
- ✓ 6 letter quality fonts, 2 draft fonts, 8 bar code types including POSTNET
- ✓ Maximum paper width (tractor feed): ML590, 10.5"; ML591, 16.5"
- ✓ Optional user-installable color module kit
- ✓ OKISMAART Paper Handling™ for easy switching between paper types
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- ✓ Paper handling options: pull tractor; bottom push tractor; single sheet feeder
- ✓ Convenient front panel controls for paper movement
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ML590 **\$427.71** CDW 24899

ML591 wide carriage **\$579.12** CDW 24900

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Okidata ML320 and ML321

The 9-pin printer for demanding applications

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- ✓ 240 x 216 dpi maximum graphics resolution
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- ✓ 250 cps maximum utility quality print speed
- ✓ 300 cps maximum draft quality print speed
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- ✓ Convenient front panel controls for paper movement
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- ✓ 1 year parts and labor warranty



ML320 **\$299.88** CDW 10676

ML321 wide carriage **\$427.40** CDW 10618

OKIDATA®

dot matrix printers

Model	Carriage width	Pins	Features	CPS HS draft	CPS draft/utility	CPS NLQ	CPS LQ	CDW price	CDW
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ML321	wide	9	28KB buffer	300	250	63		\$427.40	10515
ML520	normal	9	64KB buffer	430	320	80		\$365.77	27668
ML521	wide	9	64KB buffer	430	320	80		\$486.27	27670
ML590	normal	24	optional color	450	360	120		\$427.71	24899
ML591	wide	24	optional color	450	360	120		\$579.12	24900
ML380	normal	24	8KB buffer	240	182	63		\$212.43	15526
ML285	wide	24	64KB buffer	607	466	242	162	\$966.07	29571
ML285C	wide	24	64KB buffer color	607	466	242	162	\$1039.74	29572
Pacemark 3410	wide	9	parallel/serial interface	550	417	104		\$1213.95	21815

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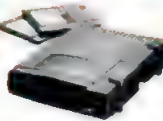
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intel.

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EtherExpress 16 combo 5pk	549.72
EtherExpress Flash 10BT	111.88
EtherExpress Flash 10BT 5pk	519.90
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iomega

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ML521	486.27
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ML591	579.12
Pacemaker 3410	1213.95
OL400E	394.68
OL410E	539.89
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BJ100	209.99
BJ200X	229.86
BJ230	391.55
BJC600A color	471.99
BJC4000 72dpi + color	349.78

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AP2250	96.54
AP2350	146.65
AP3280	167.82
LP300	165.65
FX870	288.45
FX1170	374.86
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LQ1070+	375.26
LQ1070	454.44
LQ1170	623.51
LQ2550	965.08
DPX5000 Plus	1384.01
Stylus 300	182.27
Stylus 300+	183.18
Stylus 800+	211.14
Stylus 1000	436.15
Stylus Color	509.53
ActionLaser 1100	383.62
ActionLaser 1400	582.40
ActionLaser 1500	458.62
ActionLaser 1800	785.75

LEXMARK LASER PRINTERS

WinWriter 400 laser	755.03
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ValueWriter 600 laser	815.87
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Optra R 12ppm	1423.63
Optra R 16ppm	1988.33
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425MB Fast-ATA	191.17
540MB Fast-ATA	189.52

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3233 4.3GB SCSI-2	1609.79
1836 3GB SCSI-2	1275.17

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OPTIMA 144 pocket w/fax	312.59
OPTIMA 288 V.34 internal w/fax	365.14
OPTIMA 288 V.34 external w/fax	406.55

PACKARD BELL

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SmartUPS 600	363.38
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SmartUPS 1250	644.24
SurgeArrest Network	495.07
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BC1250 LAN	426.10

Tripp Lite Smart UPS Series

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Hayes EZLink V.34 w/fax	209.87
IBM Token Ring 16/4	289.07
Linksys Ethernet combo	165.74
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Xircom Ethernet 10BT	158.69
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Xircom Ethernet+modem 10BT	396.19
Xircom Ethernet+modem combo	451.61
Xircom Token Ring 16/4	409.49

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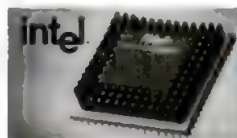


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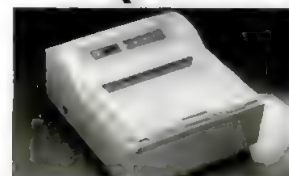
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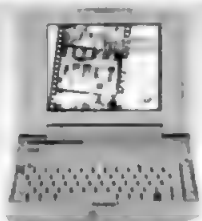
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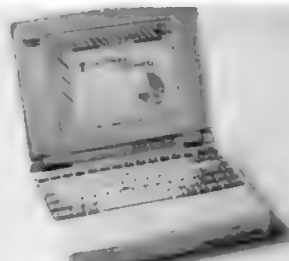
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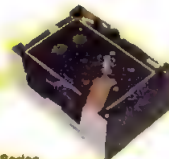
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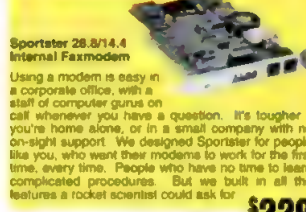
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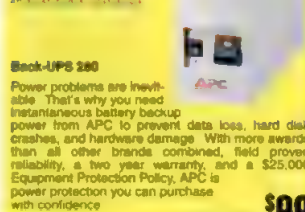
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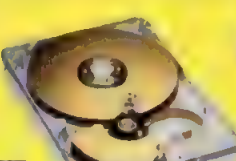
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1280MB	IDE	WD31200A	10ms	3.5" 1H	375
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4300MB	SCSI	MC3243AV	8.5ms	3.5" 1H	1,439
9100MB	SCSI	MC1891	12ms	5.25" FH	2,109
9100MB	SCSI	MC1891AV	12ms	5.25" FH	2,209
CONNER					
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2147MB	SCSI	CFP2107S	8.5ms	3.5" 1H	999
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4294MB	SCSI	CFP4297S	9ms	3.5" 1H	1,579
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4290MB	SCSI	QU94290S	8.5ms	3.5" 1H	1,529
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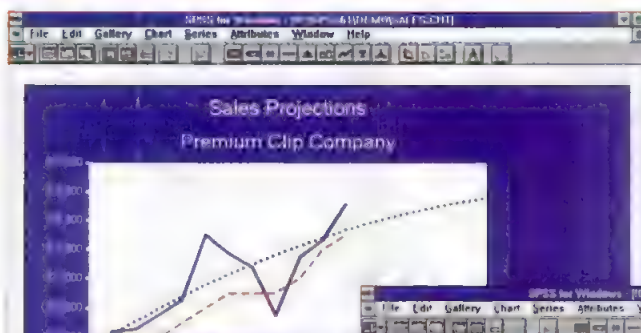
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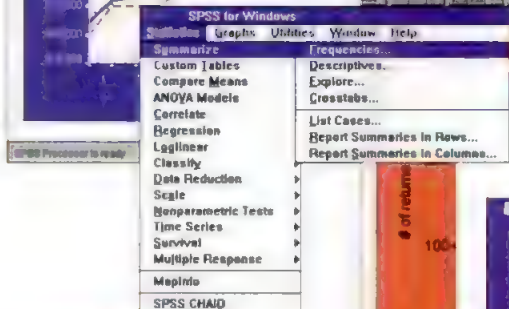
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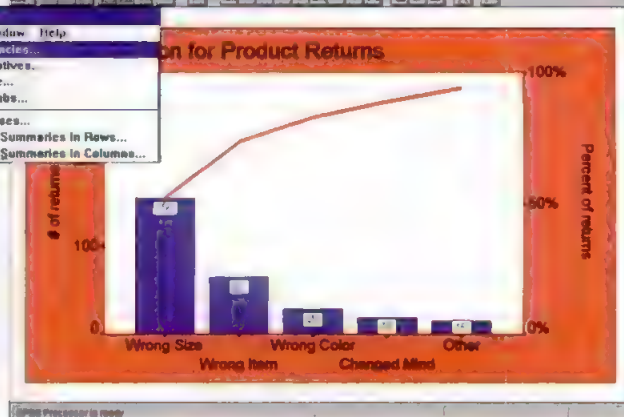
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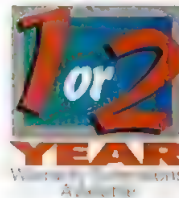
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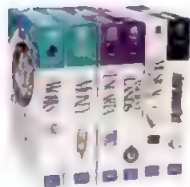
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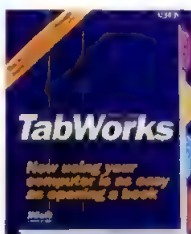
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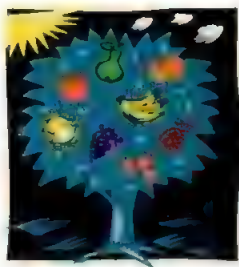


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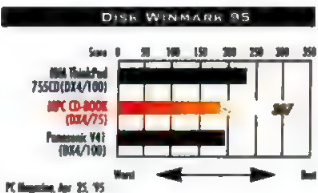
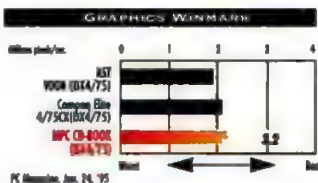
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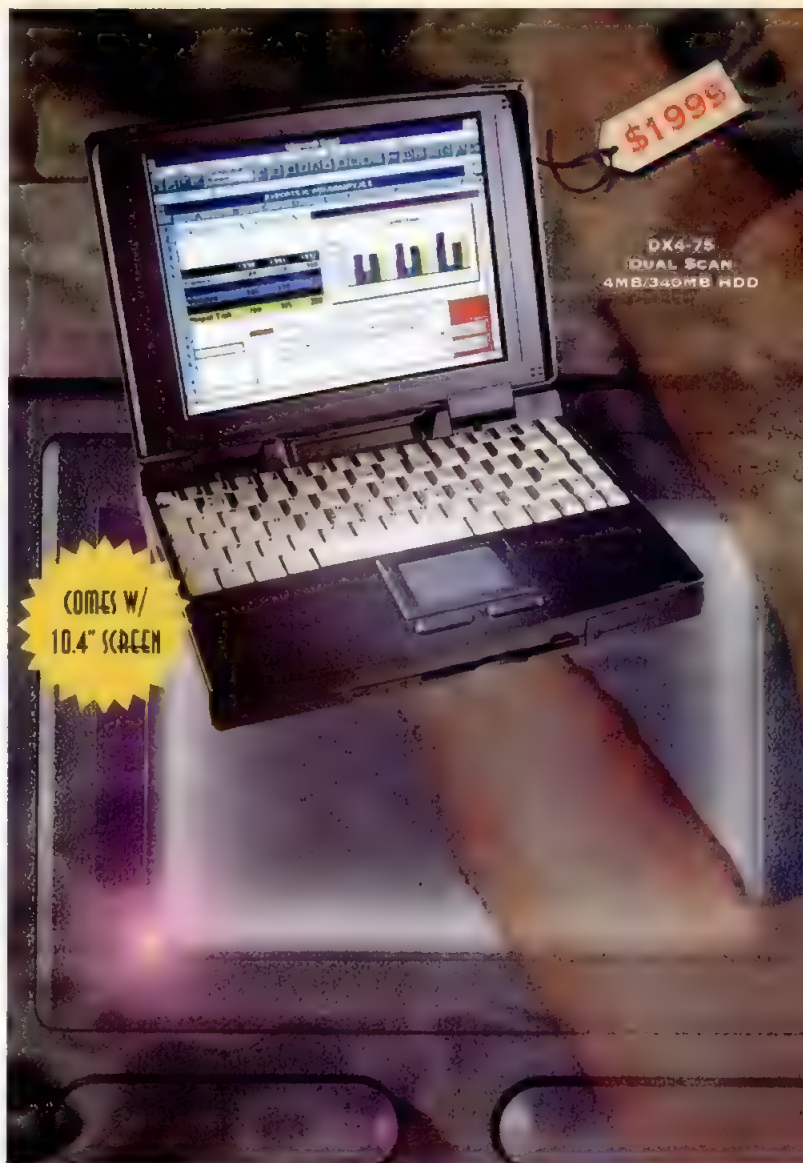
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- Built-in microphone & stereo output
- MS-DOS & Windows for Work Group
- 5.7lbs, including battery pack



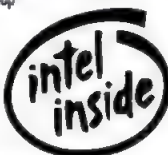
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- 4MB expandable to 32 MB
- 9.5" Dual Scan & TFT Active LCD screen
- Accelerated 32-bit VESA Local Bus VGA with 1MB
- VGA port support 1024 X 768 X 256 color
- Built-in pointing device (Versa Point)
- PCMCIA Type III slot
- 16-bit stereo (**Sound Blaster** compatible)
- NiMH battery
- Advanced power management
- **Built-in** microphone & stereo speakers
- I/O: parallel, serial, VGA & audio in/out
- DOS & Windows for Work Group
- Carrying case
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- **External 3.5" FDD**



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PCMCIA TYPE III
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DOS, Windows for Work Group & Carrying Case	
DUAL-SCAN 75MHZ, 8MB RAM & 340MB HDD	\$2,149
DUAL-SCAN 100MHZ, 8MB RAM & 340MB HDD	\$2,229
DUAL-SCAN 100MHZ, 8MB RAM & 524MB HDD	\$2,345
TFT ACTIVE-MATRIX 100MHZ, 8MB RAM & 524MB HDD	\$3,099

12 Pak CD, DOS, Windows for Work Group, Car Adapter & Carrying Case	
DUAL-SCAN 100MHZ, 8MB RAM & 524MB HDD	\$2,619
TFT ACTIVE-MATRIX 100MHZ, 8MB RAM & 524MB HDD	\$3,679

10.4" screen option on CD-Book™ is available, please contact MPC's sales department.
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MPC PCMCIA External CD-ROM Drive	\$259	MPC 16MB RAM Card Upgrade	Call
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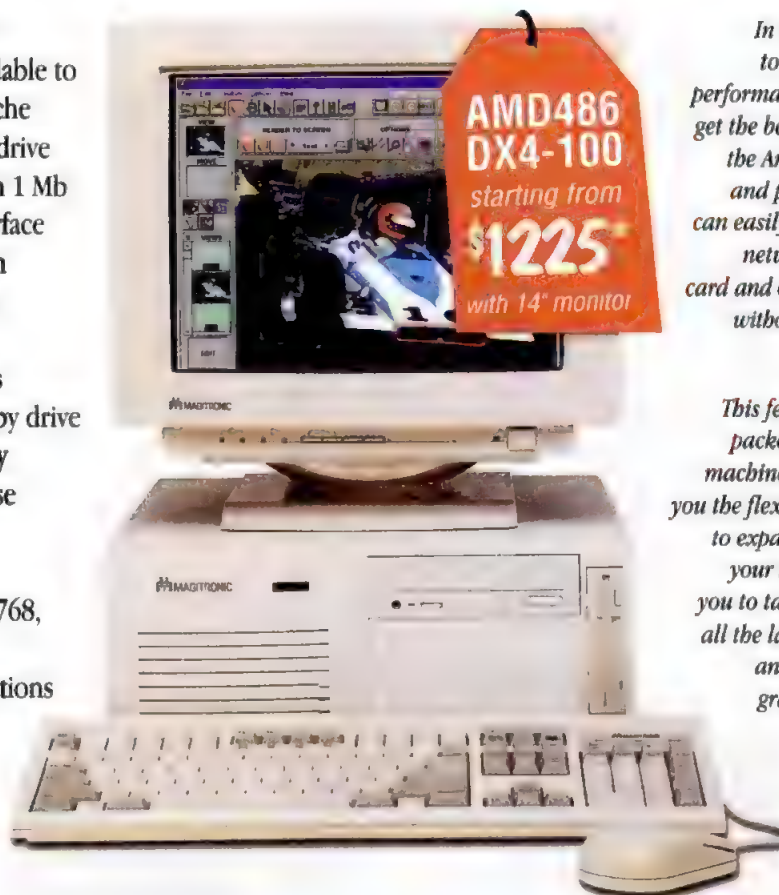
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- 8Mb RAM expandable to 128Mb, 256Kb cache
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- 14" SVGA 1024 x 768, 28mm
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▪ Quad speed
CD ROM optional



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In addition to superior performance, you get the benefits of the AmDX4-100's plug and play feature. You can easily add a modem, network card, video card and other peripherals without reconfiguring your system.

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HiNote

- All models 5.5 lbs. or less - **ONLY 1.6" thick**
- Upgradable hard drive - easily add more storage
- Built-in front mounted trackball - easy to use for right- & left-handed users
- 3-year warranty - **FREE** 1-year Passport Service

Processor	Screen	HD	Price
486SX/33	9.5" Mono	170MB	\$1379
486SX/33	9.5" Dual Scan	240MB	1879
486DX2/50	9.5" Dual Scan	340MB	1929
486DX2/50	9.5" Active	240MB	3029
486DX4/75	9.5" Active	340MB	3339
486DX4/75	9.5" Active	510MB	CALL



HiNote Ultra

HiNote Ultra

- All models 4 lbs. or less - **ONLY 1.1" thick**
- Built-in sound, microphone & speaker
- Lithium Ion battery technology
- Built-in infrared for no hassle printer connections
- 3-year warranty - **FREE** 1-year Passport Service

Processor	Screen	HD	Price
486SX/33	9.5" Mono	170MB	\$1989
486DX2/50	9.5" Dual Scan	340MB	3109
486DX2/50	9.5" Active	340MB	4339
486DX4/75	9.5" Active	340MB	4699

COMPAQ



Contura 410

Contura 410

- Upgradable hard drive - easily add more storage
- 32-bit local bus with 1MB video RAM
- Extended life NiMH battery technology
- Compaq, 3-year worldwide warranty

Processor	Screen	HD	Price
486DX2/50	9.5" Dual Scan	350MB	\$2369
486DX2/50	8.4" Active	350MB	2839



LTE Elite

LTE Elite

- 10.4" Active Matrix display
- Fast 486DX4/75 processor
- Built-in AC adapter - small, sleek design & reduced weight
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	340MB	\$3129
486DX4/75	9.5" Dual Scan	510MB	3499
486DX4/75	10.4" Active	510MB	5029
486DX4/75	10.4" Active	810MB	5389

Angia Modem

28.8/14.4, V.34
PCMCIA, SJ288

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Multimedia
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Smart Modular

SMART ST2814
28.8/14.4
V.34 fax/modem

\$299.99



Ether•Modem

14.4/14.4 & 10BaseT Ethernet

\$409.99



Modem	Description	Price
XJ1144	14.4/14.4 XJACK	\$179.99
CC3144	14.4/14.4 PCMCIA	179.99
XJ2144	14.4/14.4 XJACK GOLD	209.99
CC4144	14.4/14.4 PCMCIA GOLD	209.99
XJ2288	28.8/14.4 XJACK	389.99
CC3288	28.8/14.4 PCMCIA	389.99

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Processor Screen MB Price

Ascentia 950N New!

Pentium 75	10.4" Dual Scan	500MB	\$3439
Pentium 75	10.4" Dual Scan	800MB	3739
Pentium 75	10.4" Dual Scan	1.2GB	4229
Pentium 75	10.4" Active	800MB	4899
Pentium 75	10.4" Active	1.2GB	5399

Ascentia 810N

486DX2/66	10.4" Dual Scan	250MB	\$1969
486DX2/66	10.4" Dual Scan	340MB	2119
486DX2/66	10.4" Dual Scan	510MB	2259

Advantage Adventure Multimedia

All-N-One (4000)	486DX2/66	540MB	\$1699
Desktop (6000)	486DX2/66	540MB	1299
Desktop (6000)	486DX2/66	540MB	1599
Desktop (6000)	Pentium 75	540MB	1999
Minutower (8000)	Pentium 75	1GB	2299
Minutower (8000)	Pentium 90	1GB	2599
Minutower (8000)	Pentium 100	1GB	2799

Monitors priced separately



Ascentia
910N

Ascentia 910N

- 10.4" Active & 10.3" Dual Scan
- Lithium Ion battery technology
- Intelligent power management to maximize performance
- Integrated Smartpoint - small, accurate & easy to use

Processor Screen MB Price

486DX2/50	10.3" Dual Scan	340MB	\$2559
486DX4/75	10.3" Dual Scan	510MB	2749
486DX4/75	10.4" Active	510MB	3049
486DX4/75	10.4" Active	510MB	3829
486DX4/75	10.4" Active	700MB	4129

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IBM

ThinkPad 755 Pentiums Now Available!

- Built-in CD-ROM Drive (755CD models only)
- Built-in 16-bit sound, microphone, speaker (MIDI on 755 CD models)
- 10.4" Active (65K colors) & 10.4" Dual Scan
- 14.4 fax/modem, speaker phone, answering machine & voice mail
- Built-in infrared

Processor	Screen	MB	Price
486DX4/100	10.4" Dual Scan	340MB	\$4099
486DX4/100	10.4" Dual Scan	540MB	4449
486DX4/100	10.4" Dual Scan	810MB	4899
486DX4/100	10.4" Active	340MB	4999
486DX4/100	10.4" Active	540MB	5349
486DX4/100	10.4" Active	810MB	5799
486DX4/100	10.4" Active	540MB	6349*
486DX4/100	10.4" Active	810MB	6799*
486DX4/100	10.4" Active	1.0GB	6549
486DX4/100	10.4" Active	1.2GB	6999

*Features Built-In CD-ROM drive



ThinkPad 755CD

ThinkPad 701
as low as

\$4799



ThinkPad 701

ThinkPad 701

- Amazing pop-up, full sized keyboard w/ jigsaw design
- 10.4" Active & Dual Scan
- Only 4.5 lbs. in subnotebook form factor
- 14.4 fax/modem, speaker phone, answering machine & voice mail
- Built in 16-bit sound, microphone, speaker & MIDI
- Built in infrared for no hassle printer connections
- 20 FREE software titles preinstalled

Processor	Screen	MB	Price
486DX2/50	10.4" Active	360MB	\$4799
486DX2/50	10.4" Active	540MB	5149
486DX4/75	10.4" Dual Scan	360MB	4399
486DX4/75	10.4" Dual Scan	540MB	4749
486DX4/75	10.4" Active	360MB	5299
486DX4/75	10.4" Active	540MB	5649



ThinkPad 360
as low as

\$1999

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ThinkPad 360 & 360E

- Modular design with lift-up keyboard
- Upgradable hard drive - easily add more storage
- Removable floppy diskette drive
- IBM DOS, Windows, plus 15 FREE titles

Processor	Screen	MB	Price
486SL/33	8.4" Active	340MB	\$1999
486DX2/50	8.4" Active	340MB	3099
486DX2/50	8.4" Active	540MB	3449

PACKARD BELL



Force Minutower

4X Speed Force Desktops and Minutowers

- Quad Speed CD-ROM drive
- 16-bit SoundBlaster compatible sound card
- PCI local bus, high-speed graphics
- PCI local bus hard drive
- 14.4 fax/modem, speaker phone, answering machine
- LOADS of FREE software

Chassis	Processor	MB	Price
Desktop	Pentium 75	1.28GB	\$1929
Desktop	Pentium 100	1.28GB	2419
Minutower	Pentium 75	1.28GB	2299
Minutower	Pentium 100	1.28GB	2759

Monitors priced separately



Force Desktop

2X Speed Force Multimedia Computers

- TWO Dual Speed CD ROM Drives
- 16-bit SoundBlaster compatible sound card
- 14.4 fax/modem, speaker phone & answering machine
- LOADS of FREE software

Chassis	Processor	MB	Price
Desktop	486DX2/66	420MB	\$1399
Desktop	Pentium 75	1.08GB	1979

Monitors priced separately

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T2150

- Built-in CD-ROM Drive
- Built-in 16-bit sound, microphone, speaker & MIDI
- 10.4" Active & Dual Scan
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	500MB	\$3069
486DX4/75	10.4" Active	500MB	3699

**T4800
\$3099**



Exciting NEW Notebooks from Toshiba!

New Satellites!

Large Screens & Fast Processor

- 100MHz 486 processor
- 14.1" Active Matrix display
- 10.4" Active Matrix display
- 10.4" Active Matrix display
- 10.4" Active Matrix display

New Satellite Pro!

Pentium Powered w/ Built-in CD-ROM

- 75MHz Pentium-powered Multimedia
- Quad speed CD-ROM Drive
- 10.4" Active & Dual Scan
- Built-in 16-bit sound, microphone, speaker, MIDI & WAV support
- Lithium Ion battery technology
- Built-in AC adapter
- Integrated Accupoint
- Integrated Accupoint
- Integrated Accupoint

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Pentium Powered, Large Screen & Lightweight

- 90MHz Pentium - for blazing performance
- 9.5" display for portability
- 330MB
- 330MB
- 330MB

CALL TODAY!

**75MHz
Pentium**



T4900CT

- 75MHz Pentium - for blazing performance
- 10.4" Active Matrix display
- Built-in 16-bit sound, microphone, speaker & MIDI

Processor	Screen	HD	Price
Pentium 75	10.4" Active	772MB	\$5449



T2100

T2100

- Integrated Accupoint - small, accurate & easy to use
- Built in AC adapter - small, sleek design & reduced weight
- 10.4" Dual Scan display

Processor	Screen	HD	Price
486DX2/50	9.5" Mono	250MB	\$1419
486DX2/50	10.4" Dual Scan	330MB	2199
486DX2/50	8.4" Active	330MB	2699

Other Toshiba Notebooks

Processor	Screen	HD	Price
T4800CT			
486DX4/75	9.5" Active	500MB	\$3099
T4850CT			
486DX4/75	10.4" Active	500MB	\$3199
486DX4/75	10.4" Active	772MB	3349
T3600			
486DX2/50	8.4" Active	500MB	\$3239

**T3600
\$3239**



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HP OmniBook 600 Notebook PC

HP OmniBook 600

- Weighs as little as 3.8 lbs
- Upgradable PCMCIA hard drive - easily add more storage
- Built-in infrared for no hassle printer connections
- Instant "ON" resume feature - lasts up to 1 week

Processor	Screen	HD	Price
486DX2/50	8.5" Dual Scan	170MB	\$2419
486DX2/50	8.5" Dual Scan	260MB	2549
486DX4/75	8.5" Dual Scan	170MB	2869
486DX4/75	8.5" Dual Scan	260MB	3049

HP DeskJet
320 Printer

\$299.99

Shown with optional
feeder and color kit



HP Scanners

HP ScanJet 3P (grayscale)	\$319.99
HP ScanJet 3C (color)	349.99

HP (Colorado) Tape Drives

Trekker 350MB (portable)	\$269.99
Trekker 700MB (portable)	339.99
Jumbo 350MB (internal)	139.99
Jumbo 700MB (internal)	199.99
Jumbo 1400, 1.36GB (internal)	369.99
T1000, 800MB (internal)	199.99



HP OmniBook 4000 Notebook PC

HP OmniBook 4000

- 10.4" Active & 10.3" Dual Scan
- Built-in 16-bit sound, microphone & speaker
- Replace floppy w/ 2nd battery for 5-7 hrs. battery life
- Built-in infrared for no hassle printer connections

Processor	Screen	HD	Price
486DX4/75	10.4" Active	810MB	\$2959
486DX4/100	10.3" Dual Scan	340MB	3149
486DX4/100	10.3" Dual Scan	520MB	3459
486DX4/100	10.3" Dual Scan	520MB	2999
486DX4/100	10.4" Active	340MB	3259
486DX4/100	10.4" Active	340MB	3569
486DX4/100	10.4" Active	340MB	3429
486DX4/100	10.4" Active	520MB	3619
486DX4/100	10.4" Active	810MB	3919
486DX4/100	10.4" Active	810MB	4489*

* 16MB RAM standard

NEW! HP LaserJet Printers

HP LaserJet 5P printer (IBM, 6ppm, 600dpi)	\$587.99
HP LaserJet 5MP printer (IBM&MAC, 6ppm, 600dpi)	1039.99

HP LaserJet Printers

HP LaserJet 4L printer (IBM, 4ppm, 300dpi)	\$499.99
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HP InkJet Printers

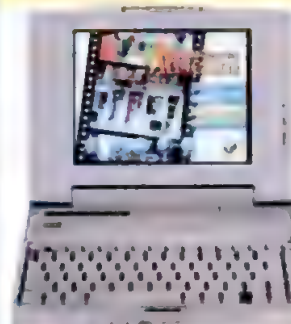
HP DeskJet 320 printer (portable)	\$299.99
HP DeskJet 320 printer w/feeder	359.99
HP DeskWriter 320 printer (portable)	299.99
HP DeskWriter 320 printer w/feeder	359.99
HP DeskJet 540 printer	289.99
HP DeskWriter 540 printer	289.99
HP DeskJet 660C printer	479.99
HP DeskWriter 660C printer	479.99
HP DeskJet 1200C printer	979.99
HP DeskWriter 1200C/PS printer	1589.99
HP OfficeJet	689.99
HP FAX-700	549.99

HP LaserJet 5P
600dpi

\$879.99



NEC



Versa M

Versa M

- High Res. displays available - 800x600 res on notebook
- True color displays available - 16.7 million colors on notebook
- Removable Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	250MB	\$2649
486DX4/75	9.5" Dual Scan	340MB	2739
486DX4/75	9.5" Active	340MB	3169
486DX4/75	9.5" Active	540MB	3449
486DX4/75	9.5" True Color	340MB	3449
486DX4/75	9.5" High Res.	540MB	3829
486DX4/100	9.5" Active	340MB	3639
486DX4/100	9.5" True Color	540MB	4199
486DX4/100	9.5" Active	810MB	4299
486DX4/100	9.5" High Res.	540MB	4299
486DX4/100	9.5" High Res.	810MB	4679

Ready Multimedia

- Quad Speed CD-ROM drive
- 16-bit SoundBlaster compatible sound card
- PCI local bus - high-speed graphics
- 14.4 fax/modem, speaker phone, answering machine
- LOADS of FREE software

Chassis	Processor	HD	Price
Minitower	486DX4/100	540MB	\$1699
Minitower	Pentium 75	850MB	1999
Minitower	Pentium 90	850MB	2299
Minitower	Pentium 90	1.2GB	2699
Minitower	Pentium 100	1.2GB	2999

Monitors priced separately.



Versa P

Versa P

- 75MHz Pentium - for blazing performance
- High Res. displays available - 800x600 res on notebook (10.4" on selected models)
- Removable Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
Pentium 75	9.5" Active	340MB	\$4349
Pentium 75	9.5" Active	540MB	4629
Pentium 75	9.5" Active	810MB	4999
Pentium 75	9.5" High Res.	540MB	4999
Pentium 75	9.5" High Res.	810MB	5389
Pentium 75	10.4" Active	540MB	4999
Pentium 75	10.4" Active	810MB	5389
Pentium 75	10.4" High Res.	810MB	5769

Versa V New Models!

- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Upgradable hard drive - easily add more storage
- 32-bit local bus with 1MB video RAM
- 64K colors on notebook display (Active only)

Processor	Screen	HD	Price
486DX2/50	9.5" Dual Scan	250MB	\$2219
486DX2/50	9.5" Dual Scan	340MB	2359
486DX2/50	9.5" Active	250MB	2359
486DX2/50	9.5" Active	340MB	2599
486DX2/50	9.5" Active	540MB	2879
486DX4/75	9.5" Active	340MB	2789
486DX4/75	9.5" Active	540MB	3069
486DX4/75	9.5" Active	810MB	3289
486DX4/75	9.5" Active	540MB	3299

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TEXAS INSTRUMENTS

TravelMate 5000

- 10.4" Active Matrix display with 2MB Video RAM
- 10.5" Dual Scan display with 2MB Video RAM
- 65K colors on notebook display
- Built-In Dual Lithium Ion batteries
- 16-bit Sound card, speaker, microphone & MIDI
- User Replaceable 772MB Hard Drive (Active)
- User Replaceable 500MB Hard Drive (Dual Scan)
- Infrared port for wireless connections

Processor	Screen	HD	Price
Pentium 75	10.5" Dual Scan	500MB	\$4999
Pentium 75	10.4" Active	772MB	\$5599

TravelMate 4000M

- Brilliant color display
- 16-bit sound card
- Integrated pointing device
- 2 Type II or 1 Type III PCMCIA slot

Processor	Screen	HD	Price
486DX2/50	9.5" Dual Scan	340MB	\$2119
486DX2/50	8.4" Active	455MB	2379
486DX4/75	9.5" Dual Scan	455MB	2459
486DX4/75	8.4" Active	340MB	2729
486DX4/75	8.4" Active	455MB	2979
486DX4/100	9.5" Active	525MB	3939

SAVE UP TO
\$200!

**75MHz
Pentium
with PCI BUS**



TravelMate 5000

Texas Round Up

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MHz 28.8 XJACK or MHz Ethernet Modem	\$ 389.99 409.99	\$339.99 \$359.99
MicroSolutions 4X portable CD-ROM or MicroSolutions portable tape drive	\$ 379.99 \$ 429.99	\$329.99 \$379.99



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- I**
- Am486™ DX4-100 processor
 - 256K write-back cache RAM
 - PCI Local-BUS Graphics with 1MB
 - Enhanced IDE interface
 - 3.5" Floppy Drive
 - Microsoft Mouse
 - 101-Key Enhanced Keyboard
 - Microsoft DOS 6.22
 - Microsoft Windows for Workgroups
 - Transporter Menu System
 - 3 Year Parts & Labor On-Site

- A**
- 8MB RAM 540MB IDE hard drive
 - 15" SVGA .28 Digital Color Monitor

\$1,549

- B**
- 8MB RAM, 850MB IDE hard drive
 - 15" SVGA .28 Digital Color Monitor
 - Double Speed CD-ROM Drive
 - 16-bit Sound Card with Premium Speakers
 - Microsoft Works Multimedia CD

\$1,799

#014002

- C**
- 16MB RAM, 850MB hard drive
 - 17" .28 Digital Color Monitor
 - Double Speed CD-ROM Drive
 - 16-bit Sound Card with Premium Speakers
 - Microsoft Works Multimedia CD

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- II**
- Am486™ DX4-100 processor
 - 256K write-back cache RAM
 - PCI Local-BUS Graphics with 1MB
 - Enhanced IDE Interface
 - 3.5" Floppy Drive
 - Microsoft Mouse
 - 101-Key Enhanced Keyboard
 - Microsoft DOS 6.22
 - Microsoft Windows for Workgroups
 - Transporter Menu System
 - 3 Year Parts & Labor On-Site

- A**
- 8MB RAM 540MB IDE hard drive
 - 15" SVGA .28 Digital Color Monitor
 - Lotus 123 or AMI PRO for Windows
 - 14.4 Fax/Modem with Software

\$1,649

- B**
- 8MB RAM, 850MB IDE hard drive
 - 15" SVGA .28 Digital Color Monitor
 - Double Speed CD-ROM Drive
 - 16-bit Sound Card with Premium Speakers
 - Microsoft Works Multimedia CD
 - 14.4 Fax/Modem with Software
 - Lotus 123 & AMI PRO for Windows

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- C**
- 16MB RAM 850MB hard drive
 - 17" .28 Digital Color Monitor
 - QUAD Speed CD-ROM Drive
 - 16-bit Sound Card with Premium Speakers
 - 14.4 Fax/Modem with Software
 - Lotus 123, AMI PRO & Approach for Windows

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PERCOMP
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PERSONAL SERIES

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- Local-BUS Graphics with 1MB
- Enhanced IDE Interface
- 3.5" Floppy Drive
- Microsoft Mouse
- Desktop or Mini Tower Case
- 101-Key Enhanced Keyboard
- Microsoft DOS 6.22
- Microsoft Windows for Workgroups
- Transporter Menu System
- 3 Year Parts & Labor On-Site

- 4MB RAM
- 540MB 10ms IDE hard drive
- 14" SVGA .28 Non-Interlaced Monitor

- 8MB RAM
- 540MB 10ms IDE hard drive
- 15" SVGA .28 Digital Color Monitor
- 14.4 Fax/Modem

Am486™DX2-66 Am486™DX2-80 Am486™DX4-100

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#011001

#011002

#011003

Am486™DX2-66 Am486™DX2-80 Am486™DX4-100

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#011004

#011005

#011006

PERSONAL MEDIA SERIES

- 256K write-back cache RAM
- Double Speed CD-ROM Drive
- 16-bit sound card, Microphone
- Premium speaker system
- Local-BUS Graphics with 1MB
- Enhanced IDE Interface
- 3.5" Floppy Drive
- Microsoft DOS 6.22 & MS-Mouse
- Microsoft Windows for Workgroups
- 101-Key Enhanced Keyboard
- Microsoft Home-Family Bundle Pack Encarta '95, Works Multimedia CD, Dangerous Creatures, Money, Arcade & Best of Windows Entertainment Pack
- Transporter Menu System
- 3 Year Parts & Labor On-Site

- 4MB RAM
- 540MB 10ms IDE hard drive
- 14" SVGA .28 Non-Interlaced Monitor

- 8MB RAM
- 540MB 10ms IDE hard drive
- 15" SVGA .28 Digital Color Monitor
- 14.4 Internal Fax/Modem



Am486™DX2-66 Am486™DX2-80 Am486™DX4-100

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ADVANCED SERIES

- 256K write-back cache RAM
- Double Speed CD-ROM Drive
- 16-bit sound card, Microphone
- Premium speaker system
- Enhanced IDE Interface
- 3.5" Floppy Drive
- Microsoft DOS 6.22 & MS-Mouse
- Microsoft Windows for Workgroups
- 101-Key Enhanced Keyboard
- Transporter Menu System
- 3 Year Parts & Labor On-Site

- 8MB RAM
- 540MB 10ms IDE hard drive
- Diamond STEALTH 64 PCI (1MB)
- 15" SVGA .28 Digital Color Monitor
- Choice of (1) Lotus Application: Lotus 123, AMI Pro, Freelance, Approach Database or Organizer

- 8MB RAM
- 850MB 10ms IDE hard drive
- Diamond STEALTH 64 PCI (2MB)
- 15" SVGA .28 Digital Color Monitor
- 14.4 Internal Fax/Modem
- Choice of (2) Lotus Applications: Lotus 123, AMI Pro, Freelance, Approach Database or Organizer

Am486™DX2-66 Am486™DX2-80 Am486™DX4-100

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#013001

#013002

#013003

Am486™DX2-66 Am486™DX2-80 Am486™DX4-100

\$1,979 \$1,999 \$2,049

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No compatibility problems with virtually any IBM-compatible PC—Windows, DOS or OS/2. No taking your PC apart to install this quad-speed drive. Just plug it into your PC printer port—plug your printer into the backpack. A simple solution from the backpack family of tape, diskette and hard drives.

"See Us At PC Expo Booth #2240"

Mr. Boddy has been murdered, and his killer reaps at large. But **tonight** today before the scheduled 8:00 p.m. reading of Mr. Boddy's last will and testament, the **Murderer Will change** the decedent to read in his or her favor.

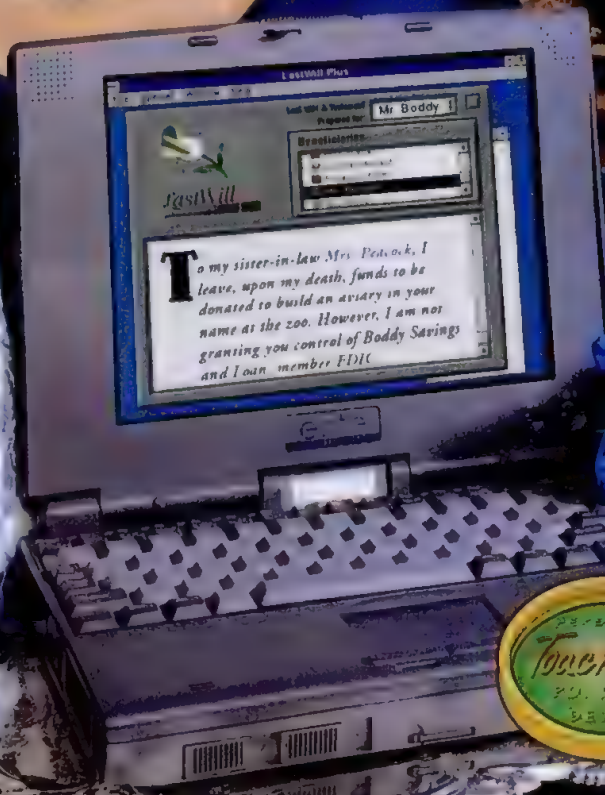
Unfortunately Boddy's **close** living relative, Mr. **Green**, is out of town on business and was not informed of his **cousin's** death. But those who **have** gathered at the Boddy mansion for the evening include Mrs. **Peacock**, an eccentric style-setter; **Colonel Mustard**, an old army buddy; **Professor Plum**, a well-traveled and classically minded; **Scarlet**, a "special friend"; and Mrs. **White**, his loyal servant of 25 years.

Please help us find the killer by determining **who** opened the will... **where**... and **what**...

MIDWEST MICRO



The Sound Book II With Convenience Is Served



Personality Modules...

THE REAL
3
YEAR WARRANTY

7:45 p.m. and tensions are high. The anticipated reading of the will is only minutes away. But with so many unique personalities in one room...MidWest Micro's SoundBook II should feel right at home!

When the main course is murder, people tend to lose their appetite—but they still hunger for convenience. And that's where the **NEW SoundBook II** comes in. Featuring a programmable Personal TouchPad, two RAM compartments and a modular design, this MidWest Micro Notebook is dressed to kill. So before we interrogate the other suspects at the table, let's investigate the SoundBook II...

Powerful Features...Weak Alibi

Who *knows* where this portable was on the night in question? Weighing only 6 lbs., it could have gone *anywhere*! Some eyewitnesses claim they saw the SoundBook II with a built-in floppy drive at 6:37 p.m. While another source swears the same drive bay was carrying an AC adapter at precisely 6:40! What makes the SoundBook II such a master of disguise?—It uses special compact peripherals, A.K.A. Personality Modules, that fit its modular 3.5" drive bay. Enjoy the floppy drive and AC adapter modules that come with your SoundBook II. And feel free to order additional modules like a 3.5" CD-ROM drive, a 14.4 Kbps voicemail fax modem, an extra hard drive and an extra battery.

Evidence Stacked In Your Favor

If *speed* is your motive, you may want to check out MidWest Micro's Pentium™ Processor Based SoundBook Plus. Like the SoundBook II, it comes with 16-bit stereo audio and built-in speakers. But this SoundBook *also* features a 75 MHz or 90 MHz Intel® Pentium Processor. And if you think *that* sounds like a setup, get a load of The Real Warranty. It covers all MidWest Micro Notebooks for a full three year sentence—parts *and* hard labor included! We can only assume that Mr. Boddy (being of sound mind) would have loved both MidWest Micro SoundBooks.

Contributing To The Delinquency Of A Diner?

Although it's unlikely that these MidWest Micro Notebooks are capable of murder, they *may* be found guilty of aiding and abetting. In fact, one of these guests may have already used a SoundBook to change Mr. Boddy's will... Perhaps Mrs. Peacock is doing it *right now*!—Or maybe she's just playing a little Microsoft® Golf.

Since we have a little time before Mr. Boddy's lawyer arrives, let's reconstruct another way this heinous crime may have been committed...

"Fastest portable we've ever tested, a fine desktop replacement"
—PC World, April 1995

"MidWest Micro wowed us with its Elite Pentium SoundBook Plus, the first Pentium-90 notebook we've tested: its performance blows every other reviewed mobile out of the water."
—PC World, March 1995

"...produced the highest Winstone 95 score of all reviewed systems"
—PC Magazine, January 1995



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MICRO**

IT'S IN OUR NATURE
Systems

1-800-682-7256

Peripherals

1-800-445-2794

Colonel Mustard



Mr Boddy

Beneficiaries

My old friend and former commanding officer, I leave all royalties from the Boddy Press Military Book Club, and hope for your continued silence about certain events which happened long ago.



In The Kitchen With A Midwest Micro PC?

"It's darn fast and darn cheap."
— PC Computing, April 1995
"The Elite P5-90 is one of the fastest computers we've tested."
— PC World, January 1995



*"I can't believe these people didn't put lunch on the itinerary," the Colonel grumbled. "And you would **think** a person with this much money could afford better lunch meat." Was it merely hunger pains that brought Colonel Mustard into the kitchen this afternoon? Or was it Mr. Boddy's Midwest Micro Home PC... and revenge!...*

Mustard hadn't touched a computer since his code cracking days in the Middle East. But this "MidWest Micro Home PC" looked nothing like *that* relic. Typing in the secret password with his one good hand, the Colonel checked his watch again. He knew exactly how long it would take the IntelDX4™ 100 Processor to find the will, make the changes and save them on the Home PC's 850 Mb hard drive. "Not bloody long at all," he said with a smirk.

Colonel Mustard had planned his strategy very carefully. And after reading six computer magazines cover-to-cover, he learned that MidWest Micro Desktop Systems are available with Intel486™ and Pentium™ Processors, double- and quad-speed CD-ROM drives, voicemail fax modems and hard drive capacities up to 1.6 Gb! And whether you order a multimedia-packed Home PC or an Office PC stocked with powerful business software, you should always expect an ambush of high performance. But even nine weeks at boot camp, two wars and a Purple Heart didn't prepare the Colonel for what he was about to witness...

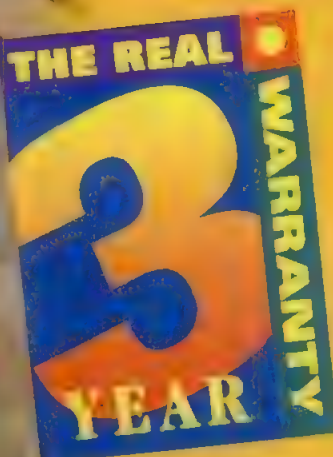
Opening the Home PC's Microsoft® Family Bundle, Mustard found an arsenal of interactive CD-ROM software—Encarta™ 95, Works, Money, Scenes, Dangerous Creatures and Golf were his to conquer. Before he knew it, the 15" color screen had exploded into multimedia mutiny. And he was even *more* impressed with Microsoft Bob™. Featuring eight household management programs in one efficient package, this new recruit had all the makings of a great soldier.

By this time the Colonel was distracted from his original covert operation. So he set a course for the library to see what Mr. Boddy's 120 MHz Office PC had to offer...

Who killed Mr. Boddy and changed his will? The rest of the investigation is up to you...

To find out "who dun it" and receive a **FREE** catalog dial 1-800-704-0318.

Systems may also include:



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Systems

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Peripherals

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MidWest Micro Home PCs

 DX2-66 PCI	\$1699	 P5-75 PCI	\$2199	 P5-100 PCI	\$3199	 P5-120 PCI	\$3899
#009401		#009402		#008758		#008769	
▶ Intel DX2™ 66 Processor		▶ Intel® 75 MHz Pentium™ Processor		▶ Intel 100 MHz Pentium Processor		▶ Intel 120 MHz Pentium Processor	
▶ 8 Mb RAM, 128 Kb Cache		▶ 8 Mb High Performance EDO RAM		▶ 16 Mb RAM, 256 Kb Cache		▶ 16 Mb RAM, 256 Kb Cache	
▶ 545 Mb IDE Hard Drive		▶ 850 Mb IDE Hard Drive		▶ 1.2 Gb IDE Hard Drive		▶ 1.6 Gb IDE Hard Drive	
▶ PCI Local Bus Graphics with 1 Mb		▶ PCI Fast IDE Interface		▶ PCI Fast IDE Interface		▶ PCI Fast IDE Interface	
▶ PCI Fast IDE Interface		▶ PCI Local Bus Graphics with 1 Mb		▶ ATI® MACH 64 PCI Accelerator with 2 Mb		▶ PCI Accelerator with 1 Mb VRAM	
▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive	
▶ Microsoft® Bob™		▶ Microsoft Bob		▶ Microsoft Bob		▶ Microsoft Bob	
▶ Microsoft Family Bundle —		▶ Microsoft Family Bundle —		▶ Microsoft Family Bundle —		▶ Microsoft Family Bundle —	
Encarta 95, Works, Money, Scenes,		Encarta 95, Works, Money, Scenes,		Encarta 95, Works, Money, Scenes,		Encarta 95, Works, Money, Scenes,	
Dangerous Creatures & Golf		Dangerous Creatures & Golf		Dangerous Creatures & Golf		Dangerous Creatures & Golf	
▶ Microsoft Complete Baseball CD		▶ Microsoft Complete Baseball CD		▶ Microsoft Complete Baseball CD		▶ Microsoft Complete Baseball CD	
▶ 16-Bit Stereo Sound Card		▶ 16-Bit Wavetable Sound Card		▶ 16-Bit Wavetable Sound Card		▶ 16-Bit Wavetable Sound Card	
▶ Digital Quality Speakers		▶ Altec Lansing® Stereo Speakers		▶ Altec Lansing Stereo Speakers with Subwoofer		▶ Altec Lansing Stereo Speakers with Subwoofer	
▶ 14.4 Fax Modem with Voicemail		▶ 14.4 Fax Modem with Voicemail		▶ 14.4 Fax Modem with Voicemail		▶ 14.4 Fax Modem with Voicemail	
▶ 3.5" Disk Drive		▶ 3.5" Disk Drive		▶ 3.5" Disk Drive		▶ 3.5" Disk Drive	
▶ 14" SVGA .28 N/A Color Monitor		▶ 15" SVGA .28 Digital Color Monitor		▶ 17" .28 Digital Color Monitor		▶ 17" .26 1600 x 1200 ExactMatch Color Monitor	
▶ 8-Bay Mini-Tower Case		▶ 8-Bay Mini-Tower Case		▶ 8-Bay Mini-Tower Case		▶ 8-Bay Mini-Tower Case	
▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots	
▶ Super I/O using 16550 UART & ECP/EPP		▶ Super I/O using 16550 UART & ECP/EPP		▶ Super I/O using 16550 UART & ECP/EPP		▶ Super I/O using 16550 UART & ECP/EPP	
▶ Signature 101-Key Enhanced Keyboard		▶ Signature 101-Key Enhanced Keyboard		▶ Signature 101-Key Enhanced Keyboard		▶ Signature 101-Key Enhanced Keyboard	
▶ Microsoft Mouse		▶ Microsoft Mouse		▶ Microsoft Mouse		▶ Microsoft Mouse	
▶ MS-DOS® 6.22 and WFW 3.11		▶ MS-DOS 6.22 and WFW 3.11		▶ MS-DOS 6.22 and WFW 3.11		▶ MS-DOS 6.22 and WFW 3.11	
▶ EPA Energy Star Compliant		▶ The Real 3 Year Warranty		▶ The Real 3 Year Warranty		▶ The Real 3 Year Warranty	



MidWest Micro Office PCs

 P5-75 PCI	\$2399	 P5-90 PCI	\$2199	 P5-100 PCI	\$2899	 P5-120 PCI	\$4899
#009406		#009407		#009409		#008785	
▶ Intel 75 MHz Pentium Processor		▶ Intel 90 MHz Pentium Processor		▶ Intel 100 MHz Pentium Processor		▶ Intel 120 MHz Pentium Processor	
▶ 16 Mb High Performance EDO RAM		▶ 8 Mb RAM, 256 Kb Cache		▶ 16 Mb RAM, 256 Kb Cache		▶ 32 Mb RAM, 256 Kb Cache	
▶ 1 Gb IDE Hard Drive		▶ 850 Mb IDE Hard Drive		▶ 1.2 Gb IDE Hard Drive		▶ 1.6 Gb IDE Hard Drive	
▶ PCI Fast IDE Interface		▶ PCI Fast IDE Interface		▶ PCI Fast IDE Interface		▶ PCI Fast IDE Interface	
▶ PCI Local Bus Graphics with 1 Mb		▶ PCI Local Bus Graphics with 1 Mb		▶ ATI MACH 64 PCI Accelerator with 2 Mb		▶ PCI Accelerator with 1 Mb VRAM	
▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive		▶ Quad-Speed CD-ROM Drive	
▶ 3.5" Disk Drive		▶ 3.5" Disk Drive		▶ 3.5" Disk Drive		▶ 16-Bit Wavetable Sound Card	
▶ 15" SVGA .28 Digital Color Monitor		▶ 15" SVGA .28 Digital Color Monitor		▶ 15" SVGA .28 Digital Color Monitor		▶ Altec Lansing Stereo Speakers with Subwoofer	
▶ 8-Bay Mini-Tower Case		▶ 8-Bay Mini-Tower Case		▶ 8-Bay Mini-Tower Case		▶ 28.8 S/R Fax Modem	
▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots		▶ 3.5" Disk Drive	
▶ Super I/O using 16550 UART & ECP/EPP		▶ Super I/O using 16550 UART & ECP/EPP		▶ Super I/O using 16550 UART & ECP/EPP		▶ 17" .26 1600 x 1200 ExactMatch Color Monitor	
▶ Signature 101-Key Enhanced Keyboard		▶ Signature 101-Key Enhanced Keyboard		▶ Signature 101-Key Enhanced Keyboard		▶ 10-Bay Full-Tower Case	
▶ Microsoft Mouse		▶ Microsoft Mouse		▶ Microsoft Mouse		▶ 4 ISA, 2 PCI & 1 PCI/ISA Slots	
▶ MS-DOS 6.22 and WFW 3.11		▶ MS-DOS 6.22 and WFW 3.11		▶ MS-DOS 6.22 and WFW 3.11		▶ Super I/O using 16550 UART & ECP/EPP	
▶ MS Word 6.0, Bookshelf, Encarta 95, Works		▶ MS® Office Professional, Bookshelf & Encarta 95		▶ MS Office Professional, Bookshelf & Encarta 95		▶ Microsoft Natural Keyboard	
▶ Multimedia Edition 3.0 & Money 3.0		▶ The Real 3 Year Warranty		▶ The Real 3 Year Warranty		▶ Microsoft Mouse	
▶ The Real 3 Year Warranty						▶ MS-DOS 6.22 and WFW 3.11	
		P5-100 PCI	\$2399	P5-90 PCI	\$2699	▶ MS Office Professional, Bookshelf & Encarta 95	
		#009408		#009410		▶ The Real 3 Year Warranty	

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Ask your sales representative how you can upgrade your monitor to a 17" or 21" MidWest Micro Monitor, your keyboard to a Microsoft Natural Keyboard, and your video card from 1.2 Mb to 4 Mb.

15" to 17" ExactMatch	\$240
15" to 17" ExactMatch	\$330
17" to 17" ExactMatch	\$110
17" to 21" ExactMatch	\$790
2 Mb to 4 Mb Video Card	Call
Microsoft Natural Keyboard	\$59




Customizing Your System

If you don't see a system configuration which meets your needs, we'll be glad to customize a system for you. Choose your own case design, amount of RAM, hard drive size and other add-ons such as modems and multimedia kits.



All Systems with a CD-ROM include TestDrive CD Software and Microsoft Home CD Sampler

MidWest Micro SoundBook Plus Based On Intel's Pentium™ Processor

- ▶ Intel® Pentium™ 90 or 75 MHz Processor
- ▶ 64-Bit, 256 Kb Synchronous Burst External Cache
- ▶ 64-Bit, 8 Mb RAM (expands to 40 Mb)
- ▶ 10.3" Dual-Scan or 10.2" Active-Matrix VGA Display
- ▶ PCI Local Bus Video with 1 Mb VRAM
- ▶ PCI Local Bus HDD Controller



- ▶ 16-Bit Stereo Audio (Sound Blaster & Windows™ Sound System Compatible)
- ▶ Built-in Stereo Speakers & Microphone
- ▶ External Jacks for Line In & Line Out
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- ▶ Microsoft® Works for Windows 3.0 & Golf
- ▶ Lotus® Organizer 2.0
- ▶ Weight: 6.8 lbs.
- ▶ Carrying Case
- ▶ The Real 3 Year Warranty



Dual-Scan Color

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#008090	\$2799
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#008025	\$3199
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#008102	\$4799
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#008103	\$5499

Options

8 Mb RAM Card	#002558	\$379
16 Mb RAM Card	#002559	\$779
MobileMax PCMCIA 130 Mb HDD	#004805	\$229
MobileMax PCMCIA 170 Mb HDD	#004806	\$345
PCMCIA 14.4 Fax Modem	#002624	\$129
PCMCIA Combo Ethernet Adapter	#001954	\$139
PCMCIA Panasonic Double-Speed CD-ROM Drive	#003728	\$295
Leather Carrying Case	#001515	\$ 99

MidWest Micro SoundBook II

- ▶ IntelDX2™ or IntelDX4™ Processor with SMM Support
- ▶ Modular Design with Personality Modules
- ▶ 4 Mb RAM (expands to 36 Mb)
- ▶ 10.3" Dual-Scan or 10.2" Active-Matrix VGA Display
- ▶ Local Bus Video with 1 Mb
- ▶ 16 Bit Stereo Audio (Sound Blaster & Windows Sound System Compatible)
- ▶ 3.5" Floppy Disk Drive
- ▶ Two Type II/One Type III PCMCIA Slots
- ▶ Personal TouchPad Integrated Pointing Device
- ▶ NiMH Battery & AC Adapter
- ▶ Advanced Power Management
- ▶ One Parallel & One Serial Port
- ▶ External VGA & Keyboard Port
- ▶ MS-DOS 6.22 & WFW 3.11
- ▶ Microsoft Works for Windows 3.0 & Golf
- ▶ Lotus Organizer 2.0
- ▶ Weight: 6.0 lbs.
- ▶ Carrying Case
- ▶ The Real 3 Year Warranty

Dual-Scan Color

DX4-75 with 340 Mb HDD	
#008141	\$1999
DX4-75 with 520 Mb HDD & 8 Mb of RAM	
#008106	\$2499
DX4-100 with 520 Mb HDD & 8 Mb of RAM	
#008142	\$2599
DX4-100 with 720 Mb HDD & 8 Mb of RAM	
#008108	\$2699
DX4-100 with 720 Mb HDD, 16 Mb of RAM & PCMCIA 14.4 S/R Fax Modem	
#008109	\$3199

Active-Matrix Color

DX4-75 with 520 Mb HDD & 8 Mb of RAM	
#008111	\$3199
DX4-100 with 520 Mb HDD & 16 Mb of RAM	
#008112	\$3799
DX4-100 with 720 Mb HDD, 16 Mb of RAM & PCMCIA 14.4 Fax Modem	
#008113	\$3999



Options

Personality Modules

— AC Adapter	#004794	\$ 79
— Battery	Call	Call
— 3.5" CD-ROM Drive	#004797	\$429
— 14.4 Fax Modem with Voicemail	#004793	\$145
4 Mb RAM Card	#006381	\$199
8 Mb RAM Card	#002558	\$379
16 Mb RAM Card	#002559	\$779
128K Cache Upgrade	#004796	\$ 69
Altec Lansing® ACS51 Speakers	#006712	\$ 69
HP DeskJet 320 Printer	#004915	\$309
MobileMax PCMCIA 130 Mb HDD	#004805	\$229
MobileMax PCMCIA 170 Mb HDD	#004806	\$345
PCMCIA 14.4 Fax Modem	#002624	\$129
PCMCIA Combo Ethernet Adapter	#001954	\$139
PCMCIA Panasonic Double-Speed CD-ROM Drive	#003728	\$295
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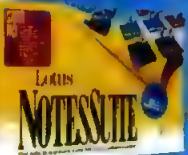
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	16mb		848
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	8mb	PA2020V	399
	16mb	PA2021V	789
T4400 SX, SXC, T6400 SXC, DXC	2mb	PA2003U	125
	4mb	PA2004U	198
	8mb	PA2005U	356
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	32mb		1548
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	16mb	PA2014U	858
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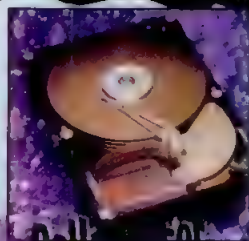
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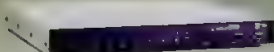
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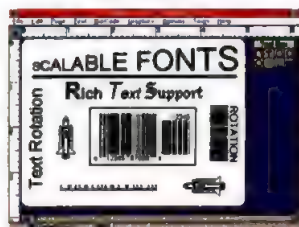
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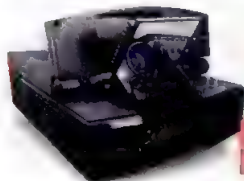
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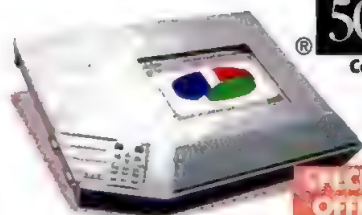
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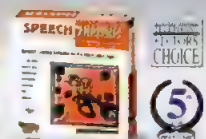
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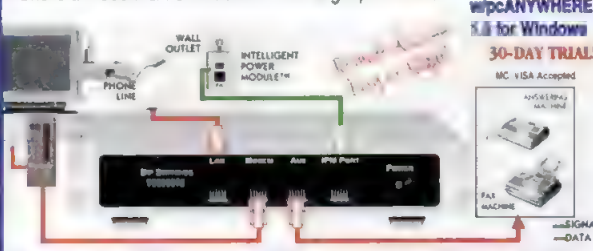
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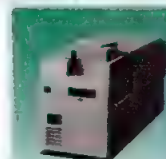
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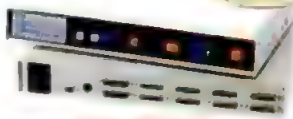
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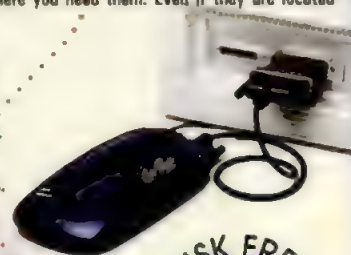
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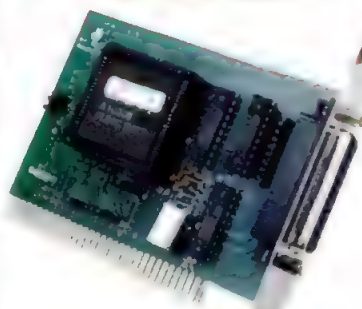
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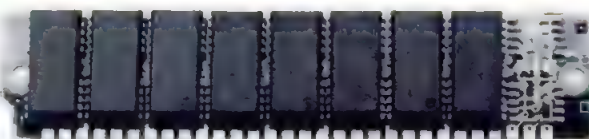
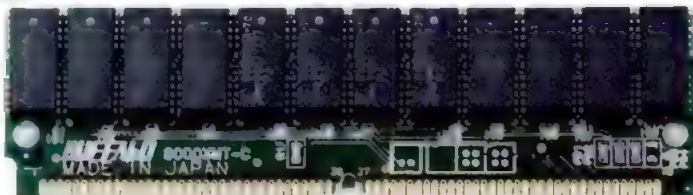


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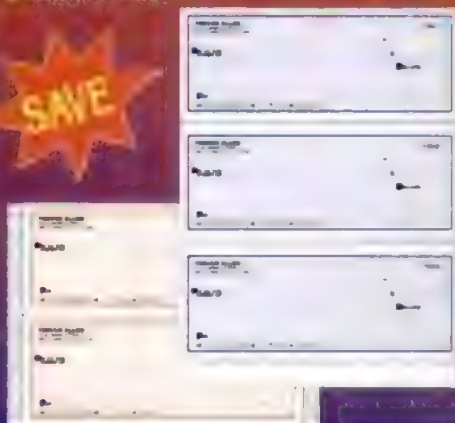
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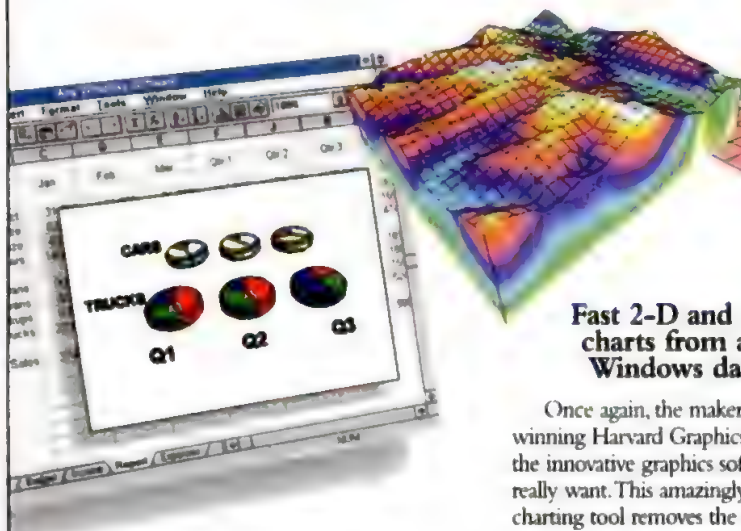
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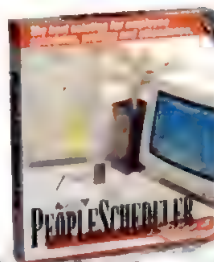
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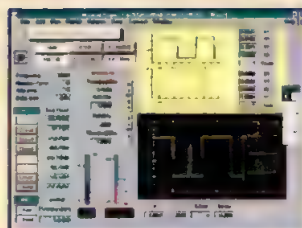
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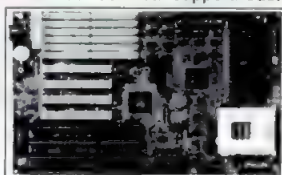
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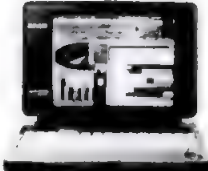
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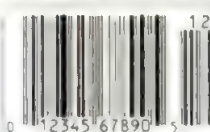
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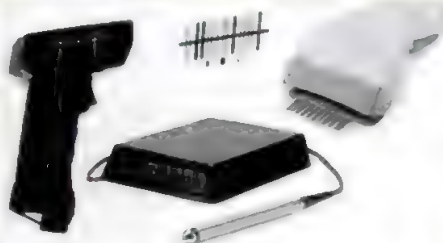
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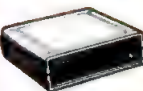
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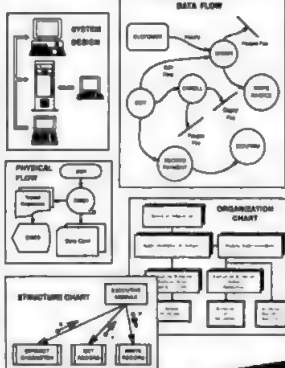
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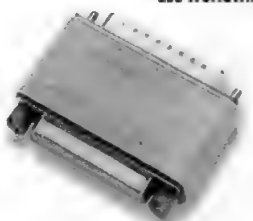
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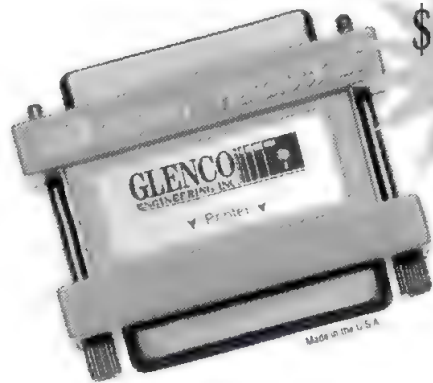
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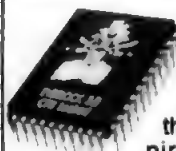
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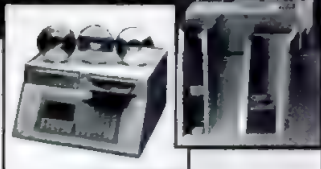
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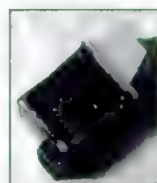
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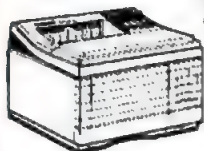
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After Hours

PC Magazine At Home



Can't stand to listen to the shake, rattle, and buzz of your old dot matrix warhorse for another second? Or are you just tired of explaining to your five-year-old why her pretty colored picture turns dull when it goes from screen to paper? Whatever your reason, there's no excuse for living in

This story is a joint project of PC Magazine and Computer Life. It is also appearing in the July issue of Computer Life.

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Making Home a More Colorful Place

By Bruce Brown

With color ink jets priced so low, there's no longer any excuse for living in a black-and-white world.

REPORT CARDS

Reading the Report Card

Print speed only tells a very small part of the story when it comes to color ink jet printers. The features discussed below will probably contribute more to the success of a printer than sheer speed alone. And they'll probably play a large part in your buying decision. We graded each of the printers in seven categories important to home users. The grades we used and their meanings are: *A*, significantly above average; *B*, above average; *C*, average; *D*, below average; *E*, failing.

Design takes into account both the physical design of the printer and the look and feel of its software interface. Important factors here include the placement and durability of the printer's case, buttons, and paper trays, as well as the ease with which you use these features. We also consider how easy it is to change ink cartridges and how much help the software gives you in creating optimal print quality.

For the **paper handling** category, we assess the printer's ability to work with a variety of different paper types, including copier paper, linen bond, 70-pound card stock, transparencies, glossy coated paper, and envelopes. To earn a good grade here, a printer has to be able to print easily on all specified paper types without requiring any special effort on the part of the user.

Performance is where we focus on the power and stability of the printer. We consider the printer's performance on our Text Speed and Graphics

Speed tests, as well as its ability to print each of our output types adequately.

Output quality measures a printer's skill at turning out attractive, true-to-the-original printouts. To score well here, a printer needs to turn out vividly colored photos, illustrations, and charts, as well as sharp monochrome and gray-scale documents. The clarity, color depth and consistency, focus, and smoothness of the printing all weigh heavily here.

Ink longevity reflects the results of our ink drain test, which measures how many pages a printer can generate at 100 percent coverage before it starts to lose color, as well as how easy it is to smudge fresh color output and how quickly the ink fades under average light conditions.

We derived the grades for **service and reliability** from *PC Magazine's* Service and Reliability survey (see "Making the Grade," January 10, 1995). In this survey, readers rated printer vendors on satisfaction with three key measures: reliability, technical support, and repair experience. To earn an A, a vendor's scores on each of these three measures had to be significantly above the overall average.

Overall value encompasses all of the above, weighed against the price of the printer and its consumables. To earn high marks here, a printer has to be well designed, easy to set up and use, and adept at handling a variety of paper types and printing tasks. It also has to have good printing speed, high-quality output, high-quality ink and a long-lasting ink supply, and a solid record for service and reliability—all at a competitive price.

the board—and treat each of these projects as if it were mission-critical. In addition to being able to handle a range of printing tasks, color ink jets must be able to handle a variety of paper types with ease, printing both on inexpensive copier paper and on special ink jet paper that costs 10 to 15 cents a sheet. Of course, they must also be easy to set up and run. And they have to do all this with an eye toward keeping the cost of supplies down.

We found ten color ink jet printers that meet these criteria. All ten units come with easily understandable, illustrated manuals and quick-start guides to help

you start printing in a hurry. While they all work just fine with DOS applications, their best features turn up under Windows, where you'll find such user-friendly extras as graphical on-line help, intelligent page analysis, and enough print control options to let you fine-tune output to your heart's content. All of these printers can handle a variety of different paper types ranging from envelopes to transparencies to linen stationery. And did we forget to mention that they can print in glorious color, yet they still cost no more than average black-and-white printers?

REVIEW CRITERIA

To be included in this roundup, ink jet printers had to be targeted for home use. They also had to be PC-compatible, be able to print in color (either natively or with an optional color kit), and have street prices of \$600 or less, though the list prices could be higher.

Five vendors submitted ten products for our testing. Eight are desktop models; two (the Canon BJC-70 and the HP DeskJet 320) are portable. Okidata is adding a new color ink jet printer that wasn't ready for this roundup.

The printers split evenly in their color offerings: five models (the DECcolorwriters 120ic and 550ic, the HP DeskJets 320 and 540, and the Lexmark ExecJet IIc) offer three-color printing, while the remaining five (the Canon BJC-70, 4000, and 600e, the Epson Stylus Color, and the HP DeskJet 660C) offer four-color printing. All of the printers offer separate black-only cartridges for monochrome and gray-scale printing. The four-color printers offer black, cyan, magenta, and yellow cartridges for printing color graphics. The three-color printers offer only cyan, magenta and yellow; they mix the three colors to create what is known as composite black. This process uses up your ink more quickly and can produce a black with a faintly greenish or brownish tinge.

For those who want the highest color quality, four-color is the way to go. The other important consideration is resolution. Two of the printers offer high-resolution color graphics modes. The Epson Stylus Color offers 720- by 720-dpi printing while the HP DeskJet 660C prints at 600-by-300, though both need

a monochrome world any longer. For somewhere between \$300 and \$600 you can add punch to your printing with the latest generation of color ink jets. These printers give personal lasers a run for their money in terms of black-and-white print quality, while adding enough rich color to turn even the grayest of skies (or documents) blue.

Color ink jets have to be versatile machines if they're going to hold a place in your home. In short, these printers have to be able to print everything from your church newsletter to your little Picasso's latest creation or your annual report to

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After Hours: PC Magazine At Home

Assessing the Output

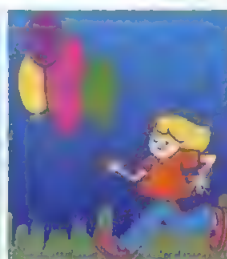
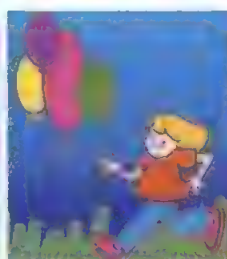
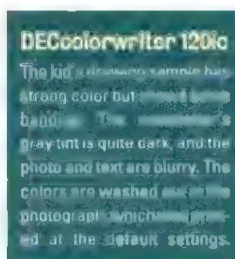
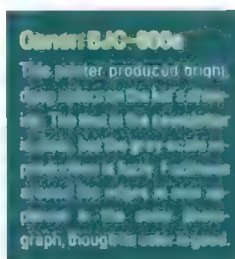
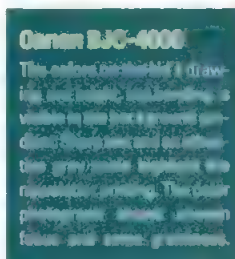
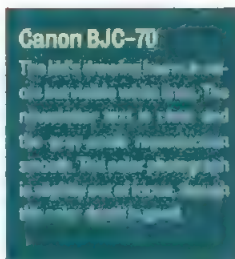
To help you evaluate the output quality of these printers, here are samples of our various print tests. There are three samples per printer: The first shows a portion of our kid's drawing, the second the gray-scale newsletter, and the third the full-color photographic image.

special paper to print at these resolutions. The 300-by-300 or 360-by-360 resolution standard on all ten printers has enough clarity and color depth for everyday printing tasks. Save the slower, more ink-intensive higher resolutions for printing presentation-quality graphics.

HOW WE TESTED

We put these color ink jets through a rigorous suite of speed and output tests. We ran PC Labs' Text Speed and Graphics Speed tests on all of the printers to see how fast they are. Speed isn't highest priority in home use needs, so we also printed a number of samples on different stock to compare the output. Among the test sheets we printed were a Word for Windows document with a variety of fonts printed on copy paper, linen stock, 70-pound card stock, and coated paper. We used CorelDRAW to print a full-color kid's illustration on plain paper to see how well the printers reproduced "refrigerator art." We also printed a Microsoft Publisher newsletter page on plain-paper stock to see how the printers handled gray-scale graphics, shaded blocks, and fine print.

To see if you really can go from the family room to the board room, we printed a business chart created in Harvard Graphics on plain paper and on transparency film. Our most technically demanding test called for each printer to reproduce a high-resolution scanned full-color photograph at its highest resolution and quality mode on expensive glossy stock so that we could see how "photo-



like" the results would be.

To evaluate ink quality and longevity, we tested fresh output for smearing and fading; we also ran an ink drain test to see just how long each printer's ink cartridge would last. For this test we loaded a fresh color cartridge in the printer, then started

outputting a page divided evenly into bars of 100 percent cyan, magenta, and yellow. The test ran until one of the colors started to drop out. In general, we found that the printers with larger ink cartridges printed more pages before they ran out of ink, an important consideration when you take into account that these larger cartridges can run as high as \$50. Smaller ink cartridges cost less but need to be replaced more frequently.

The bottom line on color ink jet print-

Our Contributors: BRUCE BROWN is a contributing editor to *PC Magazine*. SUSAN GREGORY THOMAS is a freelance writer. GAYLE C. EHRENMAN was the associate editor in charge of this story, and WILLIAM P. FLANAGAN, a staff writer at *PC Magazine*, was the project leader.

After Hours: PC Magazine

Epson Stylus Color

The colors are vibrant and clear, and the print quality is excellent. The 720-dpi resolution is a nice touch, and the overall look is professional.



ntertain

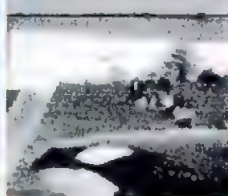


HP DeskJet 320

The kid's drawing has a very pleasing look, but the colors are a bit muted. The print quality is good, but the overall look is not as professional as the Epson.



ntertain

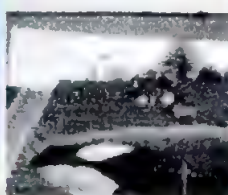


HP DeskJet 540

The colors are vibrant and clear, and the print quality is excellent. The 720-dpi resolution is a nice touch, and the overall look is professional.



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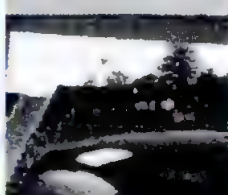


HP DeskJet 880C

The colors are vibrant and clear, and the print quality is excellent. The 720-dpi resolution is a nice touch, and the overall look is professional.

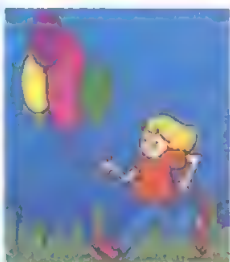


ntertain



Lexmark ExecJet IIc

Printed at the default resolution, the colors in both the kid's drawing and the photograph are somewhat muted. The print quality is good, but the overall look is not as professional as the Epson.



ers? They're practically a steal, with street prices no higher than about \$530 and color you can hang on the wall, take to school, or enclose in presentation binders. They are quiet, don't take up much space, and are easy enough for even the littlest Picasso to use yet full-featured enough for the computer-savvy. And best of all, they'll keep you from ever again having to explain why the picture is in color on-screen but in black and white on the printed page.

Canon Computer Systems

Canon BJC-70

The \$399 Canon BJC-70 (street price \$359) manages to pack high print quality and better-than-average print speed and paper handling into a portable design that's light and compact enough to fit in your backpack.

The first thing that strikes you about the BJC-70 is its size. At 2.5 by 11.8 by 6.3 inches (HWD) with the case closed and

weighing 3.1 pounds, the BJC-70 is an easy carry-along. Add the small AC adapter and some paper and you're ready for a day at the library. If need to do your printing while flying cross-country, you'll want the optional \$85 battery.

Setting up this four-color printer is easy, thanks to the included quick-start manual. If you're going to print in black only, you snap in just the black cartridge. If your artwork includes color as well as black, you insert a different cartridge that contains two separate smaller cartridges, one holding black ink and the other holding cyan, magenta, and yellow. Don't worry, though; changing these cartridges takes just seconds.

The BJC-70 handles paper with the aplomb of a larger printer. All you have to do is position the paper in the tray and watch it print. The printer's lid folds back to act as a paper input tray and holds up to 30 sheets of paper. On our tests, the printer handled card stock, linen paper, transparencies, glossy paper, and envelopes with ease.

The printer has a maximum 360-dpi resolution in color graphics mode, although there's also a 720-dpi mode for black printing only. The resident Canon, IBM, and Epson emulations and built-in fonts will come in handy if you do lots of printing from DOS, but for most of us the BJC-70's Windows printer driver and 20 TrueType fonts will see greater use.

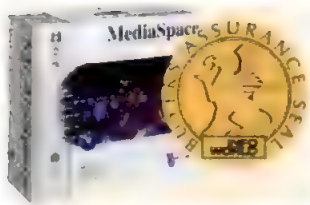
All but the most particular users will be satisfied with the BJC-70's print quality. It prints text very clearly. On our high-quality color photographic print sample test, the image it printed was a little out of focus and not as clear as the output produced by most of the other printers. The kid's drawing had rich colors but was marred by a few visible white lines between bands of ink. The chart printed on transparency film also exhibited some missed vertical lines.

The BJC-70 proves that you don't have to wait an eternity to get good output. It turned in 3.3 ppm on our Text Speed test, making it the third-fastest text printer, and posted 2.1 gppm on our Graphics Speed test,

REPORT CARD

Canon BJC-70

Design	A
Paper handling	A
Performance	B
Output quality	B
Ink longevity	B
Service and reliability	B
Overall value	A



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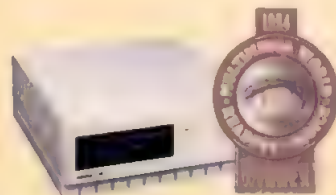
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After Hours: PC Magazine At Home



The Canon BJC-70 is small enough to carry but solid enough to use every day.

where it tied for fourth place.

The biggest drawback of this tiny printer is its lack of ink longevity. The smallest of tested printers, it also has the smallest ink cartridges: It printed the fewest full-color pages on our ink drain test, starting to lose color after only seven pages.

If you're looking for a no-excuses color ink jet printer that's equally at home on the desktop and on the road, grab a Canon BJC-70. It may not be suited to marathon printing sessions, but its strong output quality and compact size make the BJC-70 a fine traveling companion.

Canon BJC-70. List price: \$399. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 441 on reader service card

Canon Computer Systems Inc.

Canon BJC-4000

The best Canon for text use is the \$399 Canon BJC-4000 (street price \$349).

The BJC-4000 features faster printing, a more capacious sheet feeder, and slightly better output quality than its comparably priced portable sibling, the BJC-70. This Canon is a good investment if you intend to print text most of the time and color graphics only occasionally.

The four-color BJC-4000 doesn't have great physical bulk, but you'll need to provide a space 10.8 inches high by 14.3 inches wide by 13.5 inches deep to accommodate the printer. For black-only printing you use a large black ink cartridge; for color or mixed printing, there's a color

cartridge with a separate tank for black ink and another for cyan, magenta, and yellow.

The BJC-4000's sheet feeder holds 100 sheets and had no problems feeding and printing all tested paper stocks. You can put a stack of 15 envelopes into the sheet feeder or feed them manually one at a time without unloading other paper from the sheet feeder.

The BJC-4000 produces acceptable if not stellar color output. The focus was not uniform on the color photo-

REPORT CARD

Canon BJC-4000

Design	A
Paper handling	A
Performance	A
Output quality	B
Ink longevity	B
Service and reliability	B
Overall value	B

graphic image, and the chart printed on transparency film showed some visible banding. The kid's drawing had nice, bright colors but also had visible banding plus a few small spaces showing between the bands of gradient color. However, the BJC-4000 really shines when it comes to printing text. The newsletter printed with a crisp, well-differentiated gray-scale image and sharp text.

The printer's strong performance in the text arena showed up on our benchmark tests as well. The BJC-4000's 4.5-

Affordable color: HP DeskJet 540

High-end color: HP DeskJet 660C

The ten ink jet printers in this roundup offer such high quality at such an affordable price, you'll wonder why anyone chooses to go the monochrome

route. If you're ready to step up to the wonderful world of color, you'd be hard-pressed to find a better value than the HP DeskJet 540. When paired with its three-color kit, this printer offers the best price/performance matchup around. For a street price of around \$330 (which may go lower if HP follows through on plans to release an updated version of this printer), you get good monochrome and gray-scale printing, impressive color reproduction, and the solid performance you'd expect from a market leader. The one trade-off here is speed: Printing speeds for this model range from about average for text to below par for graphics.

If uncompromising graphics reproduction is of paramount importance, the printer to choose is the HP DeskJet 660C, which carries a street price of around \$499. Use glossy coated stock and the high-resolution graphics mode with this four-color printer and you'll see output that comes closer to photographic quality than you would have thought an ink jet printer could manage. The DeskJet 660C is no slouch at

plain-paper printing, either: Its color and gray-scale reproduction even on lowly copier paper is consistently clear, crisp, and vivid. Again, though, the trade-off is speed: The DeskJet 660C turned in the slowest time on our Graphics Speed test. Its score on our ink drain test, however, came to an impressive 55 pages.

Honorable mention goes to the Epson Stylus Color (street price around \$530), the leader in the ink longevity category. The color cartridge in this four-color printer is nearly three times as large as in any other ink jet, which translates to long life. On our ink drain test, the Stylus Color printed a whopping 130 pages before its colors started dropping out. This printer is also worth considering for its strong color and gray-scale output.

Finally, if you require the mobility of a portable printer, the Canon BJC-70, with an estimated street price of \$359, is the ink jet to choose. This one is small, light, and speedy; it produces good text and acceptable if not outstanding color output.



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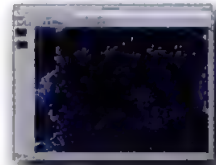
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After Hours: PC Magazine At Home

■ It's All in the Paper

By Susan Gregory Thomas

Paper's tactile nuances, as well as creative cuts and colors, add dimensions to documents that no printer can. Here is a sampling of our favorite pulpy products.

Environmentally correct papers have come a long way from the plain old recycled variety. Le Desktop (800-533-3758) produces several lines of "tree-alternative" papers whose pulp is part wood, part other organic matter. In the company's newest line, called Neptune, seaweed harvested from lagoons near Venice, Italy, produces a paper dappled with flecks of green; translucent envelopes—whose misty finish looks like clear sea glass—completes the aquatic motif. Another design, Golf, is made with grass cuttings donated by—you guessed it—golf courses. For aromatherapy devotees, Le Desktop is considering launching papers made with orange and lemon peels for a subtle, citrusy scent.

Instead of scribbling on poster board, you can design zippy-looking flyers and signs with ink jet-compatible neon papers. Available in eye-scorching yellows, reds, oranges, and blues, these papers also come in cardstock weights—handy for kids' birthday or Halloween party invitations—as well as circle and square cutouts for button making. Drop by your local

copy shop or order directly from companies like PaperDirect (800-272-7377) or Queblo (800-523-9080).

Touch-It Inc. (801-394-4300) offers a line called Touch-It Living Paper that changes color when you touch it or place it near any heat-giving surface; cool it off and the paper returns to its original hue. Living Paper comes in five metamorphosing colors: Green to Yellow, Blue to White, Purple to Pink, Teal to Yellow, and Executive Gray to White.

THE BUSINESS LOOK

You don't have to restrict your business stationery to the white-washed linen or geometric-design-of-the-month club to invoke a professional image. Uchman Ltd. (800-482-4626) offers recycled business papers in four lines presented in warm, neutral tones and elegant, unobtrusive designs that cover the entire page instead of just the borders (which makes for easier software formatting, too). To unify your presentation, each line comes with coordinated envelopes, business cards, presentation folders, and brochures; Uchman even offers desktop publishing software that includes each line's template so that you can reproduce your favorite design on the paper of your choice. PaperDirect and Queblo are also good sources for coordinated suites of business stationery.

clear and amply illustrated quick-setup guide and a toll-free technical-assistance number make setting up the BJC-600e undaunting even for novices. Once you put in the main print cartridge, you snap in separate tanks for black, cyan, magenta, and yellow ink.

The 100-sheet paper input tray works smoothly. In a welcome break from the pack, Canon lets you feed envelopes horizontally (the way you would hold them if you were reading them). This makes it easy to get envelope printing right the first time. On our

tests, the BJC-600e proved equally adept at handling specialty paper stock.

The printer also turned out consistently above-average output. The kid's draw-



Consistently vivid color output is the hallmark of the Canon BJC-600e.



The Canon BJC-4000 is a superior text printer though less adept at color.

ppm text speed made it the leader among the printers in our test group, and its 2.5-gppm graphics printing speed put it into second place. But speed is not an indicator of staying power, and the BJC-4000 didn't last very long on our ink drain test: The yellow ink started to degrade after just 21 pages.

The Canon BJC-4000 is a good deal if you're interested in a solid text printer that can also crank out the occasional color graphic. If a steady stream of refrigerator art is what you're after, you'd do well to look elsewhere.

Canon BJC-4000. List price: \$399. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 442 on reader service card

Canon Computer Systems Inc.

Canon BJC-600e

Canon's \$549 BJC-600e (street price \$499) is the color graphics champ of the Canon triad. Intended for people who print color graphics most of the time and text occasionally, the BJC-600e balances slow text printing speed and average graphics printing speed against superior print quality.

To get great graphics printing, the four-color BJC-600e has 64 nozzles per color compared with 24 for each color in the other Canon models. Like the other Canon printers, the BJC-600e is a 360-dpi printer, with a 720-dpi smoothing mode for crisp black printing.

Canon uses environmentally kind packaging for this printer, wrapping it in unbleached paper and recycled paper board instead of the more common Styrofoam. A

REPORT CARD

Canon BJC-600e

Design	A
Paper handling	A
Performance	B
Output quality	B
Ink longevity	B
Service and reliability	B
Overall value	B

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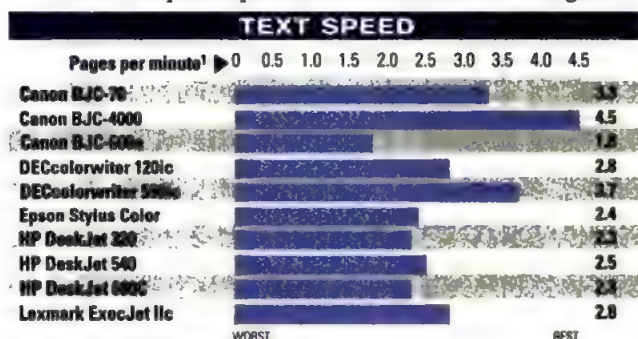
Benchmark Tests: Color Ink Jet Printers

The ten color ink jets we tested proved that print quality and print speed don't necessarily go hand in hand. In many cases, the better the output, the slower the printer—especially when it comes to printing graphics.

What the Numbers Mean

The fastest printer on our Text Speed test was the Canon BJC-4000, which produced 4.5 pages per minute. The DECcolorwriter 550ic came in second with 3.7 ppm; surprisingly, Canon's new portable BJC-70 followed slightly behind with 3.3 ppm. Bringing up the rear was Canon's BJC-600e, which had a text printing speed of 1.8 ppm.

On our Graphics Speed test the two fastest were again



1 Mathematically derived from raw scores in characters per second.

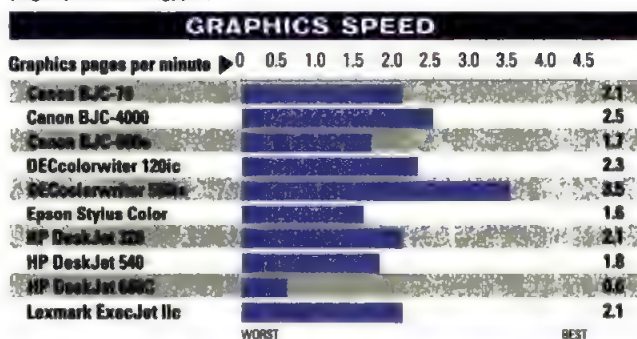
the DECcolorwriter 550ic and the Canon BJC-4000. This time, though, the DECcolorwriter 550ic placed first, with 3.5 graphics pages per minute, followed closely by the Canon BJC-4000 at 2.5 gppm. The HP DeskJet 660C lagged far behind, with just 0.6 gppm.

How We Tested

The test-bed used for these printer tests was a Hewlett-Packard Vectra XU 5/90C, a 90-MHz Pentium with 16MB of RAM and a 540MB hard disk, running MS-DOS 6.2 and Windows 3.1.

The **Text Speed** test measures the printer's speed in producing one copy of a two-page business letter. Speeds are reported here in pages per minute (ppm); they are mathematically derived from the characters-per-second score generated by the test.

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, and line art. For this test, the print file is sent directly to the parallel port from DOS. Results for all printers are reported in graphics pages per minute (gppm).



ing had vivid color, with good depth and clarity. The chart printed on transparency film looked fit for a boardroom presentation. The newsletter page printed on plain paper had a slightly soft gray-scale image, but the text output was sharp. The color photographic image printed on glossy paper was excellent, exhibiting just a little fuzziness.

Quality like this takes time, though. The BJC-600e's 1.8-ppm text speed was the lowest of the tested printers. Its 1.7-gppm graphics speed was average. Ink longevity was better than average, however; the printer turned out 38 pages before the first color (magenta) started to give out.

Canon's best graphics printer, the BJC-600e, produces very good output, but it's not a printer for the impatient.

Canon BJC-600e. List price, \$549. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 443 on reader service card.

Digital Equipment Corp.

DECcolorwriter 120ic

Digital Equipment Corp.'s DECcolorwriter 120ic is the least expensive color ink jet printer in this roundup. It costs \$355 (street price \$279), but you get exactly what you pay for. Overall, it turned out lackluster output and suffered from a few design quirks that made it tougher to use than it should have been.



The DECcolorwriter 120ic is the least expensive color ink jet in this review.

The three-color DECcolorwriter 120ic has a 300-dpi maximum resolution, with separate cartridges for black-only printing and for cyan, magenta, and yellow. The printer's documentation and accessories are neatly organized in a plastic tray that nestles in otherwise standard packaging. An illustrated quick-setup guide takes the confusion out of the initial setup experience. After the initial setup, though, operating the printer can get a bit confusing.

You can load up to 70 sheets of paper in an input tray that extends from the rear of the printer. After you load the paper but before you can print, you must find and activate two unusual levers on the front of the printer to center the paper and lock it in place for feeding. You can print on envelopes, but they must be fed manually, one at a time. The ink cartridges are easy to snap in and out, and each fits in its own space in a protective case when not in use. When you

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switch between cartridge types, however, you'll have to do more lever legerdemain so that the printer can recognize the cartridge type.

The output quality of the DECcolorwriter 120ic falls short of the higher marks set by the other printers in this roundup. Its newsletter output was too dark and somewhat fuzzy. The chart printed on transparency film showed abrupt color changes where they should have been gradual and also had unintended vertical lines. The color photographic image printed on glossy paper was quite pale at the printer's default settings. The kid's drawing output was the best of the 120ic's test samples, though it had visible banding. Overall, the printing was disappointing.

Print speed was acceptable: The 120ic had a text speed of 2.8 ppm and a graphics speed of 2.3 gppm. And ink consumption costs should be low: On our ink drain test, the magenta color bar started missing lines after 25 pages, a moderate number.

If dollar cost is your sole criterion, this is the printer to buy. The output quality isn't quite up to the level of the other printers in this roundup, but you may find it acceptable for ordinary use.

DECcolorwriter 120ic. List price: \$355. Digital Equipment Corp., Maynard, MA; 800-777-4343, 508-493-5111; fax, 800-234-2298.

Circle 444 on reader service card

Digital Equipment Corp.

DECcolorwriter 550ic

Digital's second color ink jet printer, the DECcolorwriter 550ic, is larger and faster; it also holds more paper than the 120ic. Listing at \$399, the 550ic sells for about \$329 but doesn't produce much better output quality than its lower-priced sibling.

Like the 120ic, the DECcolorwriter 550ic is a three-color printer with a maximum resolution of 300 dpi. It shares the same cartridge strategy as its sibling, has the same well-organized setup guide—and, unfortunately, suffers from many of the same operational problems. The 550ic has a different case design, however, and different paper feed mechanisms, which

REPORT CARD	
DECcolorwriter 120ic	
Design	B
Paper handling	B
Performance	B
Output quality	C
Ink longevity	B
Service and reliability	C
Overall value	C

make it slightly easier to use. Up to 150 sheets of paper fit into a front-loading paper tray and follow a U-shaped paper path to exit into an output tray that is also located in the front of the printer. As with the 120ic, envelopes must be fed manually, one at a time.

The DECcolorwriter 550ic produced generally better output than the 120ic but still wasn't competitive with the other ink jet printers in this review. The best image the 550ic produced was the kid's drawing, which had banding problems similar to those in the sample produced by its sibling. The newsletter sample produced less fuzzy text samples than the 120ic, but the overall image was still dark. The chart printed on transparency film exhibited banding in its gradient background. The color photographic image was pale when printed on the default settings but improved when we fiddled with the brightness and contrast; despite these adjustments, the image remained



The DECcolorwriter 550ic excelled on our Graphics Speed and Text Speed tests.

somewhat out of focus.

Though its output quality may not be stellar, the 550ic is rather speedy. It finished second on our Text Speed test, at a speed of 3.7 ppm, and placed first on our Graphics Speed test, at a speed of 3.5 gppm. With ink longevity test results almost identical to those of the 120ic (which is logical since the printers use the same cartridges), the 550 started missing lines in the magenta color bar after 25 pages.

The DECcolorwriter 550ic gets mixed reviews. It's fast and easy to set up, but its

output quality just isn't up to par.

DECcolorwriter 550. List price: \$399. Digital Equipment Corp., Maynard, MA; 800-777-4343, 508-493-5111; fax, 800-234-2298.

Circle 445 on reader service card

Epson America Inc.

Epson Stylus Color

The Epson Stylus Color printer may have the highest list price (\$699) and estimated street price (under \$530) of the printers in this review, but the long-term cost of ownership is likely to be quite low thanks to long-lasting ink cartridges.

In addition to being able to print loads of pages per ink cartridge, this printer offers rugged design and excellent output, including a very high-quality 720-dpi mode.

Epson uses standard packaging for the Stylus Color printer. The main manual has ample drawings and diagrams to make it easy to get started. A separate manual offers tips for improving your color print quality.

You couldn't ask for a simpler design than this printer offers. An L-shaped paper path exits finished pages onto an output tray directly above the front-loading, 100-sheet-capacity input tray. Envelopes are printed in portrait mode, straight up; you don't have to put them in sideways, and they can be stacked up to 10 at a time in the input tray. All you have to do to feed envelopes is to adjust a paper thickness lever and reverse a paper tray guide. Both adjustments take only seconds.

The Epson Stylus Color lived up to its reputation as a terrific-quality ink jet printer, turning out some of the best output in this roundup. Most of the time you'll probably use this four-color printer's 360-dpi mode, which is well suited for all but the most demanding of color print jobs. When only the best will do, though, you'll want to use the high-resolution 720-dpi print mode, which is suggested for use only with special Epson 720-dpi coated and glossy papers. This paper costs about 12 cents a sheet for the coated stock and \$1 a sheet for the glossy, but the results are worth the expense.

We printed our color photographic

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Kurt Roemer, Searle Corp.

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R. Morella

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image in 720-dpi mode on Epson's glossy paper and found the results excellent in terms of both color and overall focus. Printing the same image on non-Epson paper produced usable if less remarkable results. If you're not going to use the special paper, go for the 360-dpi print mode instead. We printed our kid's drawing on plain paper in this mode and found the colors deep and true, with just faint banding visible around the edges. The chart printed on transparency film showed some unusual texturing in the background. In the newsletter printing sample, however, the Epson was the clear winner.

REPORT CARD	
Epson Stylus Color	
Design	A
Paper handling	A
Performance	B
Output quality	A
Ink longevity	A
Service and reliability	B
Overall value	A

The gray-scale image was the smoothest and most realistic we saw, and the text was sharp and strong.

The trade-off for this Epson's great printing quality appears to be speed. At a 2.4-ppm text speed and a 1.6-gppm graphics speed, the Stylus Color placed only midrange on our print speed ratings. Perhaps more significantly, however, it proved to be more than twice as fast on graphics printing as its closest four-color competitor, the HP DeskJet 660c.

While it may be no speed demon, the



The Epson Stylus Color offers a 720-dpi graphics mode that produces outstanding results.

Epson is easily the Energizer Bunny of color ink jet printers. Where many of the other printers in this roundup started to show color dropout after 25 sheets on our

SUMMARY OF FEATURES

Color Ink Jet Printers

■ YES ■ NO

	Canon BJC-600e	Canon BJC-4000	Canon BJC-70	DECcolorwriter 120ic	DECcolorwriter 550ic	Epson Stylus Color	HP DeskJet 320
List price (base configuration)	\$549	\$399	\$399	\$355	\$399	\$699	\$379
Dimensions (HWD, in inches)	10.5 x 16.2 x 12	10.8 x 14.3 x 13.5	2.5 x 11.8 x 6.3	10 x 14 x 14	6.9 x 15 x 19.8	7.5 x 18.5 x 20.5	2.8 x 12.2 x 5.8
Weight (pounds)	9.9	7.9	3.1	8.8	11.0	16.3	7.5
Number of jets (black/color)	256, 256	128, 136	128, 136	50, 51	50, 51	64, 48	54, 48
Maximum graphics resolution (dpi)	360 x 360	360 x 360	360 x 360	300 x 300	300 x 300	720 x 720	600 x 300
Parallel/serial port	■ ■	■ ■	■ ■	■ Optional	■ Optional	■ ■	■ ■
Macintosh-compatible	■	■	■	■	■	■	■
Paper Handling							
Maximum paper width (inches)	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Rated maximum paper weight (pounds)	28	28	28	24	24	24	24
Input paper capacity (sheets)	100	100	30	70	150	100	60
Prints on card stock/transparencies	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Prints on 8-size paper/envelopes	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Pressure/tractor feed	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Paper paths	Rear L	Rear L	Rear L	Rear U, Front L	Rear U	Front L	Front L
Landscape printing	■	■	■	■	■	■	■
Fonts and Features							
Emulations	Canon BJ-10, Canon Extended Mode, Epson LQ-2550, IBM Proprinter X24E	Canon BJ-10, Canon Extended Mode, Epson LQ-2550, IBM Proprinter X24E	Canon BJ-10, Canon Extended Mode, Epson LQ-2550, IBM Proprinter X24E	HP DeskJet 500C	HP DeskJet 500C	ESC/P2	HP DeskJet 500C
Number of resident/scalable typefaces	5, 0	5, 0	5, 0	4, 0	5, 0	5, 4	4, 15
Cost per monochrome page/percent coverage	2¢, 5%	3¢, 5%	4¢, 5%	2¢, 5%	2¢, 5%	5.3¢, 15%	5¢, 5%
"Ink cartridge low" indicator	■	■	■	■	■	■	■
Color Capability							
Uses 3-color/4-color ink cartridges	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Has a separate cartridge for each color	■	■	■	■	■	■	■
Cost of color page/percent coverage	14¢, 30%	27¢, 30%	32¢, 30%	11¢, 15%	11¢, 15%	13.2¢, 45%	22¢, 15%
Driver provides default settings based on intelligent analysis of the page	■	■	■	■	■	■	■
Driver lets user control color	■	■	■	■	■	■	■
Customer Support							
Toll-free technical support/BBS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Telephone support hours (eastern time)	8:00 A.M.-11:00 P.M. M-F, 11:00-6:00 Sat	8:00 A.M.-11:00 P.M. M-F, 11:00-6:00 Sat	8:00 A.M.-11:00 P.M. M-F, 11:00-6:00 Sat	8:00-6:00 M-F	8:00-6:00 M-F	9:00-9:00 M-F	10:00-9:00 M, T, Th, Fri; 10:00-7:00 Wed
Warranty length (parts and labor)	2 years	2 years	2 years	2 years	2 years	2 years	1 year

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ink drain test, the Epson rolled on and on, finally beginning to show degradation in the magenta color bar after 125 pages. Just for the record, yellow lasted for 130 pages and cyan for 143. Much of this longevity can be attributed to the printer's larger-than-average ink cartridge.

The Epson Stylus Color is a top choice. Its first-rate color and gray-scale output, incredibly long-lasting ink cartridges, sturdy construction, and simple operation make it a winner. At present, its somewhat higher price may be the only deterrent to buying this printer.

Epson Stylus Color. List price: \$699. Epson America Inc., Torrance, CA; 800-289-3776, 310-782-0770; fax, 310 782-4214. Circle 446 on reader service card

Hewlett-Packard Co.

HP DeskJet 320

The HP DeskJet 320 (base price \$379) may be small and easy to tote, but trade-offs in the printer's design may make you want to think twice before you buy. We tested this portable printer with its optional sheet feeder and color kit; the combination lists for \$504 and usually sells for around \$400.

The DeskJet 320 uses the same print engine and same ink cartridges as its desktop relative, the DeskJet 540. Like that unit, the DeskJet 320 is a three-color printer with a maximum resolution of 300 dpi for color printing and 600 dpi for black-only.

Setting up the DeskJet 320 requires careful reading of the manual, particularly for attaching and using the sheet feeder and for changing cartridges. The sheet feeder, without which you have to feed paper manually one sheet at a time, is a galaxy-like design with foldout arms; it holds 60 sheets. You have to snap the printer firmly into the feeder, then tilt the printer forward. When you tilt the printer back to replace depleted cartridges or to switch between the black and three-color ink cartridges, the force required and the noise it makes may lead to you think you're breaking the feeder.

Another drawback is that the DeskJet 320 isn't designed to print envelopes—a significant problem if you don't have another printer and an inconvenience even if you do. In a welcome touch, though, the printer's Windows driver uses HP's proprietary ColorSmart technology to analyze your page, choose the appropriate print settings based on the contents of the page, and signal for the proper cartridge if you have the wrong one installed. Of course, you can override the settings the software selects.

Choosing your own settings might well be the best route. On our tests, the HP DeskJet 320 consistently turned out pale print samples. Three images—the kid's drawing, the chart printed on transparency film, and the color photograph—were pale and looked washed out. The newsletter had somewhat fuzzy text and gray-scale image reproduction. The Canon BJC-70, the only

other portable printer in this review, produced better text and gray-scale output, as well as slightly better color output.

Printing speed was somewhat low for the DeskJet 320 on the Text Speed test, at 2.3 ppm and—typical for HP ink jets—very low on the Graphics Speed test, in

this case 2.1 gppm. Its ink consumption, however, is admirably low for a portable. On our ink drain test, the DeskJet 320 printed 26 pages before the magenta bar started to degrade, whereas the Canon BJC-70 turned out only 7.

The HP DeskJet 320 is a rugged portable that works well overall, but its awkward paper-handling design and inability to print envelopes make it take a back seat to the HP

REPORT CARD

HP DeskJet 320

Design	B
Paper handling	C
Performance	B
Output quality	B
Ink longevity	B
Service and reliability	A



The HP DeskJet 320 offers unusually good ink consumption for a portable printer.

DeskJet 540 as a low-cost printing option and to the excellent Canon BJC-70 as the portable printer of choice.

HP DeskJet 320. List price: \$379; with sheet feeder and color kit, \$504. Hewlett-Packard Co., Santa Clara, CA; 800-752-0900; fax, 800-333-1917.

Circle 447 on reader service card

Hewlett-Packard Co.

HP DeskJet 540

To many people, desktop ink jet printing means the HP DeskJet 540. When you add a \$49 color kit (containing a three-color ink cartridge and cartridge case) to the base model DeskJet 540 (\$365 list), its price with the components comes to \$414 (it has an estimated street price of around \$330). What

PC MAGAZINE EDITORS' CHOICE

HP DeskJet 540	HP DeskJet 660C	Lexmark ExecJet IIc
\$365	\$599	\$379
7.9 x 17.2 x 16	7.9 x 17.2 x 16	6.9 x 14 x 10.3
11.6	11.6	11.0
54, 48	48, 48	56, 48
600 x 300	600 x 600	300 x 300
■ ■ ■	■ ■ ■	■ Optional
■	■	■
8.5	8.5	9
36	36	32
100	100	15
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
Front U	Front U	Rear L
■	■	■
HP DeskJet 500C	HP DeskJet 500C	HP DeskJet 500C, IBM Proprinter X24E
4, 4	4, 4	5, 3
3¢, 5%	4¢, 5%	3.2¢, 5%
■	■	■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
22¢, 15%	11¢, 15%	19¢, 15%
■	■	■
■	■	■
10:00-9:00 M, T, Th, Fri; 10:00-7:00 Wed	10:00-9:00 M, T, Th, Fri; 10:00-7:00 Wed	10:00-7:00 M-F
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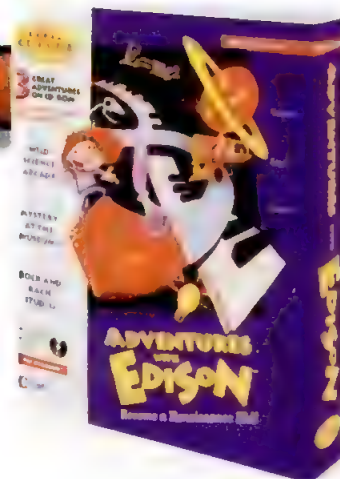


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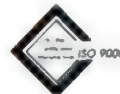
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you get for this fairly low price is good or often great color and monochrome output, average speed and ink longevity, terrific paper handling, and the less tangible benefit of buying the most popular ink jet printer made. The DeskJet 540 may not be available much longer, though: HP reportedly will release an updated version, with some new features and a new name, by fall. Of course, that should translate into an even lower price for the DeskJet 540 for as long as it remains on the shelves.

Like the DeskJet 320, the three-color DeskJet 540 has a maximum graphics resolution of 300 dpi and a black-only resolution of 600 by 300 dpi. In addition to



High performance at a low price distinguishes the HP DeskJet 540.

using standard protective packaging materials, Hewlett-Packard shrink-wraps the components in the carton, which protects the contents and facilitates organization. Inside the manual's front cover you'll find toll-free support numbers in case the manual's many illustrations don't provide enough help.

Up to 100 sheets of paper fit into the DeskJet 540's front-loading input tray and exit to a two-stage output tray, first resting on a pair of winglike supports and then dropping on top of the previously printed pages. The paper-handling mechanisms work well, and you can put a stack of 20 envelopes into the input tray, to be fed with the short edge leading so that the address is printed in landscape mode.

The DeskJet 540 produced better-looking output than the DeskJet 320. The newsletter sample had a nice gray-scale

REPORT CARD

HP DeskJet 540

Design	A
Paper handling	A
Performance	B
Output quality	B
Ink longevity	B
Service and reliability	A
Overall value	A

image with clearer text than that of the DeskJet 320, and the chart printed on transparency film was really quite good, judged second only to that of the HP DeskJet 660C. The color photographic image had sharp, rich colors and even focus but was just a bit soft, as if viewed through a fine filter, and the output on the kid's drawing was too light. But overall, the output was commendable, especially when you consider the low cost of the printer.

The DeskJet 540's 2.5-ppm text speed was about average, though its graphics printing speed was fairly slow. At 1.8 gppm, it was the fastest of the HP printers tested but still only half as fast as the next-slowest non-HP printer. With the same ink cartridges and print engine as the DeskJet 320, the DeskJet 540 lasted for a nearly identical 27 pages on our ink drain test before the magenta ink started to fail.

For a bargain price, the DeskJet 540 delivers solid operation, good output, and a clean design. It's no wonder this is the best-selling ink jet printer on the market.

HP DeskJet 540. List price: \$365; with color kit, \$414. Hewlett-Packard Co., Santa Clara, CA; 800-752-0900; fax, 800-333-1917.

Circle 448 on reader service card

Hewlett-Packard Co.

HP DeskJet 660C



The new HP DeskJet 660C has drawn a thick line in the sand for its competitors—a line of rich, sharp colors. The color and monochrome output of this four-color printer cannot be beaten by any other color ink jet. With a list price of \$599 (and a street price of \$499), as well as the Hewlett-Packard reputation for reliability, the DeskJet 660C is the printer to choose if output quality is your overriding concern.

This updated version of the popular DeskJet 560C uses the same case as the



If you're interested in uncompromising color output, turn to the HP DeskJet 660C.

DeskJet 540, with slight modifications of its paper-handling mechanism. Unlike its lower-priced sibling, the DeskJet 660C is a four-color printer, with a maximum resolution of 600-by-300 dpi in color on glossy and special coated paper, 300 dpi in color on plain paper, and 600 dpi in black-only printing.

Like the DeskJet 540, the DeskJet 660C holds 100 sheets or 20 envelopes in its input tray and can print on just about any standard stock. A single-envelope slot lets you leave regular paper in the input tray while you print out a quick envelope. This model differs from the older 540 in its handling of ink cartridges. In the 660C, you install both the black and color cartridges at the same time for true four-color printing.

The DeskJet 660C has a new print engine and Windows driver that are rated faster than those for the DeskJet 540; however, on our benchmark tests the results were a little slower on the newer unit. The printer turned in a 2.3-ppm text speed in normal 300-dpi print mode and a 0.6-gppm graphics speed.

REPORT CARD

HP DeskJet 660C

Design	A
Paper handling	A
Performance	B
Output quality	A
Ink longevity	B
Service and reliability	A
Overall value	A

If speed is not a concern but great output quality is, buy this printer and you'll be very happy. The 660C's reproduction of our color photographic image was exceptionally sharp, with extremely deep, rich colors. The kid's drawing and the chart printed on transparency film were the best of the lot. The only test in which the 660C did not take top honors was the newsletter sample. The gray-scale image and the text were not as sharp as the ones

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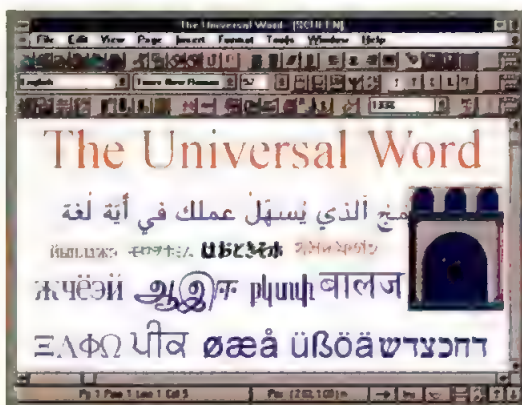
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CIRCLE 367 ON READER SERVICE CARD

After Hours: PC Magazine At Home

produced by the Epson Stylus Color, and the gray tints showed a fair amount of dithering.

The inks used in the HP 660C cartridges have formulas different from those of earlier models, resulting in richer colors and more pages per cartridge. Ink longevity was twice as long as that of the DeskJet 320 and 540 models, running for 55 pages before the yellow bar started to miss lines on our ink drain test.

The HP DeskJet 660C has stunning output and good ink life, though it can be painfully slow when printing graphics. If output quality is your primary concern, the DeskJet 660C is the printer to buy. **HP DeskJet 660C.** List price, \$599. Hewlett-Packard Co., Santa Clara, CA; 800-752-0900; fax, 800-333-1917. Circle 449 on reader service card

Lexmark International Inc.

Lexmark ExecJet IIc

Lexmark International's \$379 ExecJet IIc (street price \$299) may not be the performance leader of the ink jet pack, but its speed, output quality, and ink longevity add up to a good deal at a competitively low price. The price of this three-color printer should drop a bit more when Lexmark introduces the four-color WinWriter 150 later this year (estimated street price \$350).

The ExecJet IIc has an illustrated user guide that helps make short work of printer setup. After you've installed the printer you can put the main manual away and

rely on a pocket-size help guide for maintenance, troubleshooting, and answers to common questions.

The ExecJet IIc keeps track of the current black and color ink cartridges (even when you remove them to switch between monochrome and three-color printing) and flashes a low ink light to let you know when there is only enough ink left to print approximately 30 color pages and 150 monochrome pages. A small cartridge holder/protector snaps onto the side of the sheet feeder to store the alternate ink cartridge.

On our tests, the ExecJet IIc proved to be a solid performer. Its paper handling is faultless, and you don't have to reload often, thanks to the sheet feeder's 150-sheet capacity. You can feed envelopes one at a time manually or stack them 15 high in the automatic sheet feeder. The ink cartridges snap in easily, too.

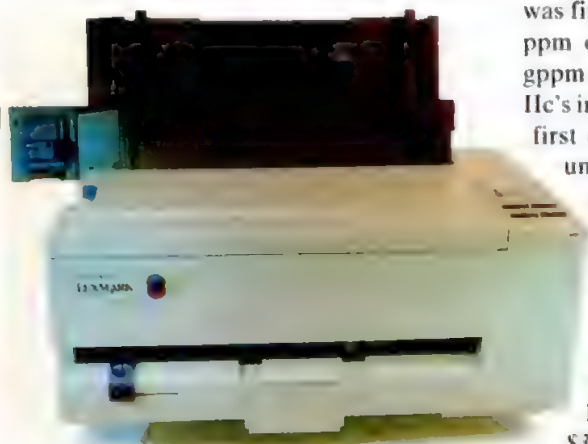
The printer's output quality should be adequate for most purposes. In comparison with the other printers in this roundup, the ExecJet IIc printed somewhat light, less vibrant color samples. Occasional banding showed on the kid's drawing, on the business chart printed on transparency film, and on the color photographic image printed on glossy paper. The newsletter sample was hurt by a coarse gray-scale image and overly dark and dense text shading. Adjusting the printer driver settings was easy and improved the ExecJet IIc's output quality, but its out-of-the-box settings kept it from excellence.

Printing speed, on the other hand, was fine, with the printer turning in 2.8 ppm on our Text Speed test and 2.1 gppm on Graphics Speed. The ExecJet IIc's ink longevity is also very good. The first color, yellow, didn't start to fail until the 46th page at 100 percent coverage.

A solid choice that offers great paper capacity, better-than-average ink longevity, decent output quality and speed, and good design, the Lexmark ExecJet IIc gives you your money's worth. □

Lexmark ExecJet IIc. List price: \$379. Lexmark International Inc., 800-438-2468, 606-232-2000; fax, 606-232-2380. Circle 450 on reader service card

REPORT CARD	
Lexmark ExecJet IIc	
Design	A
Paper handling	A
Performance	B
Output quality	B
Ink longevity	B
Service and reliability	C
Overall value	B



The Lexmark ExecJet IIc is a solid performer with a reasonable price.

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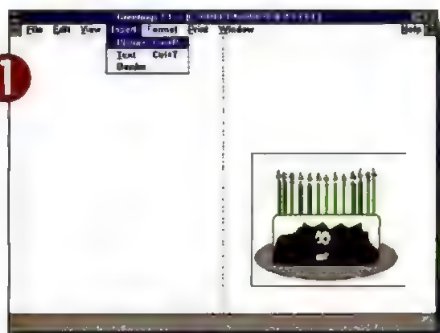
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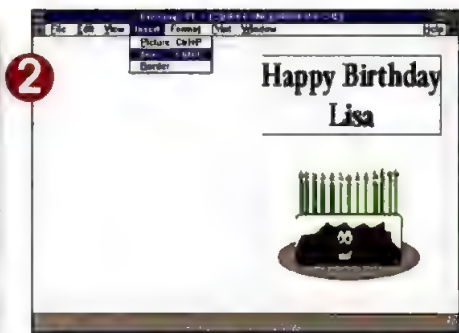
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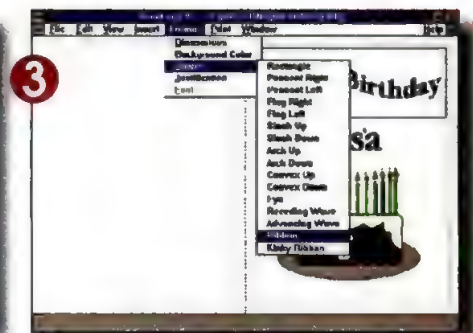
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CIRCLE 031 ON READER SERVICE CARD

After Hours

EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

DOS

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CD-ROM

Resource-Intensive

Adult Content

Kids (Ages)

Price

Design Tools for the Rest of Us: Personal Creativity Software

You can spend big money on a desktop publishing program and turn yourself into an electronic Gutenberg. But those programs can be difficult to use, and don't you want more than just a way to position type on a page?

You really need a creativity program that helps you design all kinds of projects, from retail-sales signs to personal greeting cards. Five programs—CardShopPlus! Deluxe, Greeting Cards Etc., Print Artist CD Edition, The Print Shop Deluxe CD Ensemble, and Stationery Store—handle cards, and most do a lot more.

To evaluate these programs, we looked at how easy they are to use, how attractive their artwork is, how many different projects they can create, and how attractive these projects look.



Here are sample greeting cards created with (from left to right) The PrintShop Deluxe CD Ensemble, Print Artist CD Edition, CardShopPlus! Deluxe, Stationery Store, and Greeting Cards Etc.

The Print Shop Deluxe CD Ensemble

Broderbund Software Inc.;
415-382-4639.

Circle 453 on reader service card

★★★★★ \$79.99

This venerable publishing package remains one of the best bargains around for designing simple publishing projects. With the latest CD version, you get all you need for creating everything from party invitations to business cards to mailing labels. This CD-ROM includes

the contents of five previously released products: The Print Shop Deluxe, The Print Shop Deluxe Companion, Business Graphics, Sampler Graphics, and Amazing Animal Graphics.

Creating a greeting card (or any of the other projects) could hardly be easier. Just pick a design and personalize it by adding text and images to the appropriate spots. You're free to modify the basic layout any way you like, or you can start with a blank page and work from scratch.

Each project design relies

on four backdrop libraries ranging from business themes to artistic, sentimental, and seasonal designs. After selecting a backdrop, you move to the actual layout, which combines graphics and text in different ways depending on the project you select.

With The Print Shop Deluxe, you get just about all the art and type you'll ever need for any publishing job. The disk contains 73 True-Type fonts and more than 1,600 different graphics in black and white or color. Furthermore, you can import

.BMP, EPS, Photo CD, TIFF, and .WMF files.

The only drawbacks here are the lack of pinpoint placement for graphics and text and the fact that the program handles text in a quirky way. To create your message, you write in a separate text window, which you must return to for editing the greeting or changing the font. Despite these flaws, Print Shop Deluxe is ideal for most small design jobs. The program's short learning curve and wealth of clip art make it the right type for the home publisher.

Print Artist CD Edition

Maxis; 800-336-2947.

Circle 454 on reader service card

★★★★★ \$59.95

This program is proof positive that you can design anything you need for home or small business without shelling out the big bucks. Just load this electronic easel and let your own imagination do the rest.

To get started, pick one of the program's predesigned documents. You may choose among business, educational, and personal themes. You can also choose a blank template and design from scratch. If you can't find what you need in the program's library of more than 2,300 images, you can import .BMP, EPS, .GIF, .PCX, TIFF, and .WMF images. Print Artist supports True Type and Postscript Type 1 fonts and includes more than 100 fonts.

Print Artist includes a

After Hours

search tool for finding just the right image from the image libraries. You can search by selecting text in your document or by entering a category or keyword. The toolbar at the top of the screen can also make your work go faster, once you've spent a few hours learning the commands associated with the different buttons.

Although similar to Print Shop Deluxe in its approach to document design, this creativity booster gives you better control over text and graphics. Here, control handles appear on object frames to let you



Print Artist CD Edition includes more than 2,300 pieces of clip art and 100 fonts for enhancing your designs.

quickly size, rotate, and place objects anywhere on the page. To edit text, you jump from a preview screen back to the layout screen; you won't get the interactive WYSIWYG editing you find in expensive desktop publishing programs.

Print Artist is fun and easy to use. With an effective design and a well-written guide, this program is definitely fit to print.

CardShopPlus! Deluxe

Mindscape; 415-883-3000.

Circle 455 on reader service card

★★★   \$69.95

There's no doubt that making greeting cards should be a primary function of a program called CardShopPlus! Deluxe. But you can

also make posters, certificates, banners, and more.

CardShopPlus! Deluxe takes the guesswork out of art design by offering a series of templates and basic greetings for the sentimentally impaired. The program has far less artwork than you get in Print Shop or Print Artist but more than you get in Stationery Store. You can also import images in .BMP, Photo CD, and .WMF formats.

To create a greeting card, you must first master the pair of toolbars that frame the screen's workspace. The top row of icons contains broad themes, such as birthdays, office greetings, and general-purpose designs. The vertical toolbar on the right changes as you click on one of the top buttons to provide a selection of specific designs within each of the broader categories. This push-button design makes working with CardShopPlus!

Deluxe unnecessarily confusing. It takes too much time to decipher the pictures and functions for each operation and to figure out the relationships between the toolbars. The program has a search tool for looking up illustrations, but this feature is so slow that you'll soon become frustrated.

If all you want to do is make quick cards or signs, other programs offer larger image libraries and are easier to use. But if you're not confident about writing your own cards, the canned sentiments in CardShopPlus! Deluxe may outshine these limitations.

Stationery Store

*DogByte Development;
800-545-7677.*

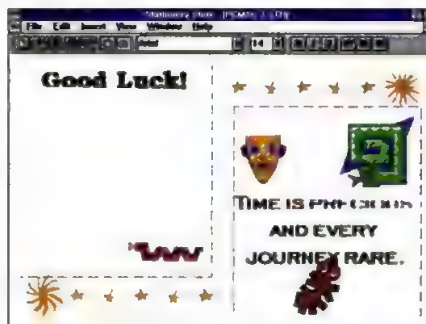
Circle 456 on reader service card

★★★   \$69.95

With a package named Stationery Store, you may think that anything you can get on paper you can get from this program. Think again. This package is limited to creating greeting cards, letterheads, and custom envelopes.

For making cards, you can choose from 38 templates, each with a border and a few appropriate clip-art images. After you make your selection, other images are available from the thumbnail icons at the top of the workspace area. The thumbnail images displayed relate to the theme of your card; you are free to browse the icons and select from different themes, however. The designs themselves, though few in number, have a professionally artistic flair. If you want to work with your own images, you have to be sure they're in either .BMP or .WMF format.

With Stationery Store, it's easy to get your design on the page but much harder to man-



Stationery Store offers a limited number of project types for you to create, but its artwork is quite attractive.

nipulate images on the screen. You enter text directly into your design, but because the program doesn't use frames to

indicate selections, you have to be careful not to delete, move, or change the wrong object.

Without all of the tools and options provided by other personal publishers, Stationery Store probably won't be your one-stop design shop.

Greeting Cards Etc.

finTech Software Corp.;
800-272-7792.

Circle 457 on reader service card

★★★   \$69.95

Greeting Cards Etc., rather than giving you card-making templates and suggestions, includes 48 greeting cards that are already printed with artwork.

The program's interface begins as a virtual card shop. Just ring the bell on the counter for help and service, or select one of the cards from the spinning rack. After picking the card you want, you can choose from several different greetings and sentiments. After that, it's a few short steps to inserting the receiver's name and putting your own name and thoughts on the card. You can even delete the supplied greeting and add your own. You can also add any of the clip art included with the program or import graphics in .BMP, JPG, .PCX, Pict, Targa, TIFF, or .WPG format.

Making a card this way is probably faster than driving to the store to buy one, but getting the card out of your computer can be just as frustrating as finding a parking space on Saturday morning. The program leads you through a trial-and-error process to identify how your printer works and to help you align the card properly. But be prepared to waste a few cards or several sheets of paper to get it right.

—Peter Scisco

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February 1994
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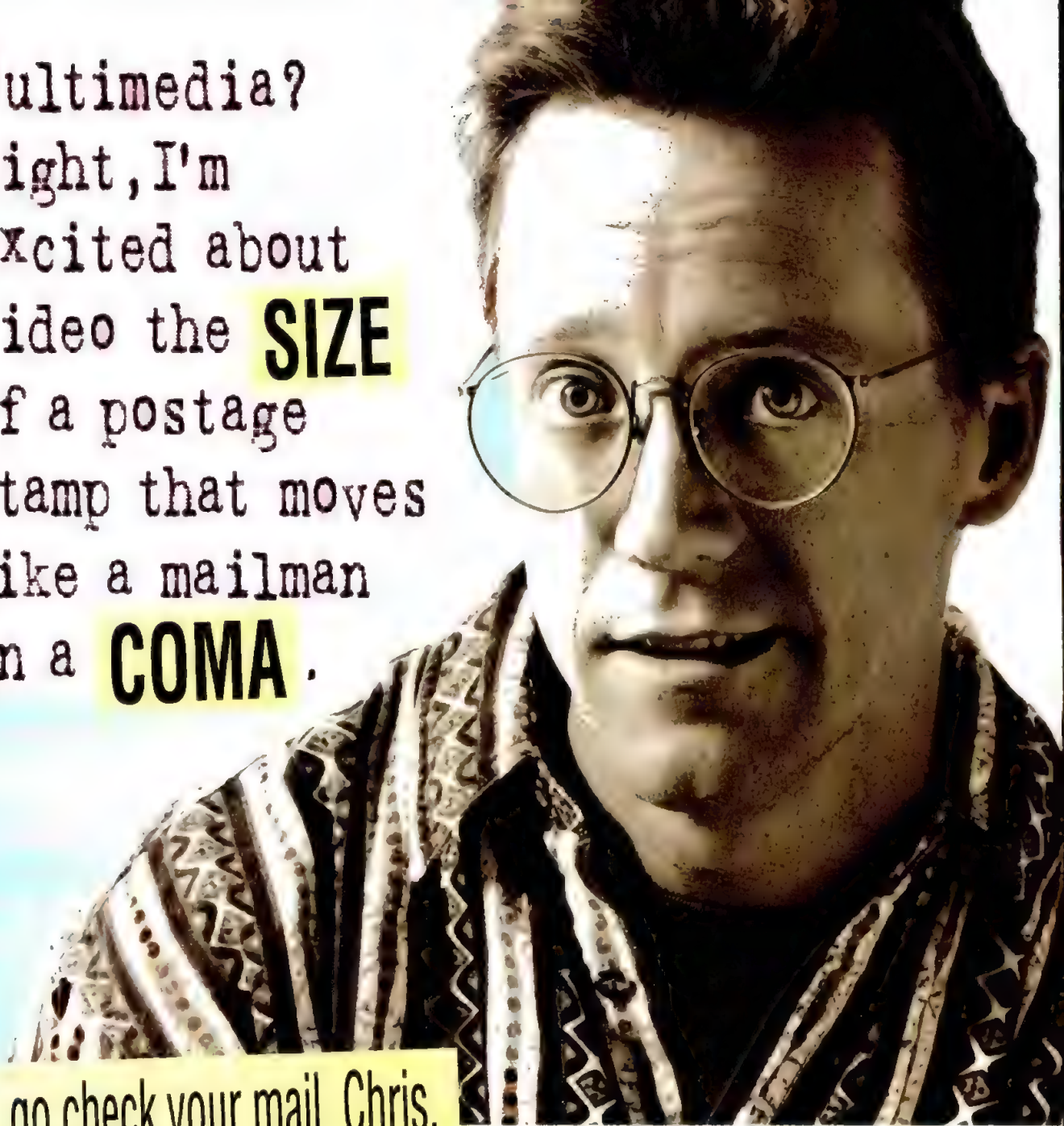
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Coming Up

Notebooks Galore

Full-featured notebooks now rival the capabilities of desktops. Multimedia notebooks with integrated CD-ROM drives are a reality. Subnotebooks are lighter than ever. Pentium notebooks are finally here en masse. PC Magazine Labs tests over 70 color notebooks to see which ones deserve a place in your briefcase—or on your desktop as a replacement for a traditional PC. We also give you a guide to travelers' tricks that can make remote computing easy.

Contact Management Software

Contact management isn't what it was. More and more people are telecommuting, traveling, and spending good chunks of time out in the field. At the same time, businesses are becoming more workgroup-oriented: People want and need to share information. In this contact management software roundup, we look at 15 packages of varying complexity. We home in on the workgroup capabilities of these packages by testing how well the packages share information across a network, determining whether they can handle group scheduling, and exploring whether they can perform remote database synchronization. So even if you're not a salesperson, you may find that one of these packages has what you need to manage your contacts, your schedule, and a lot more.

Portable Printers

A portable printer can be the perfect companion to your notebook PC, especially if you often need to produce hard copy on the road for contracts, make last-minute changes to presentations, or the like. But the only way you'll take a portable printer with you consistently is to find one that has the right mix of light weight, quality output, speed, and ease of use. Some emphasize portability at the expense of speed, while others deliver desktop-printer-quality output but might weigh you down. *PC Magazine* looks at seven portable printers that address these concerns in different ways.

Solving the Remote Riddle

You expect your network to be like 7-Eleven: open 24 hours a day and accessible wherever you happen to be. And new remote-access products are making it easier than ever for roaming users to link to the office. Remote access is showing up everywhere, making its way into operating systems such as Microsoft Windows 95 and OS/2 Warp. And whereas today you have to choose between remote-control and remote-node, the two are converging in new ways. We test and evaluate 13 remote-node servers and 9 remote-control packages, and also report on new products and trends.

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NE—Network Edition.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

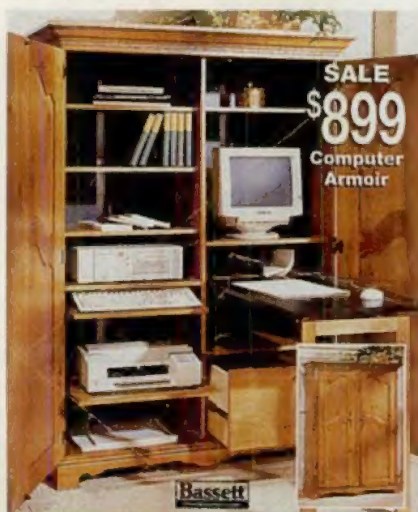
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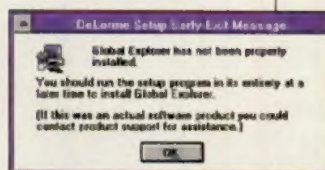
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